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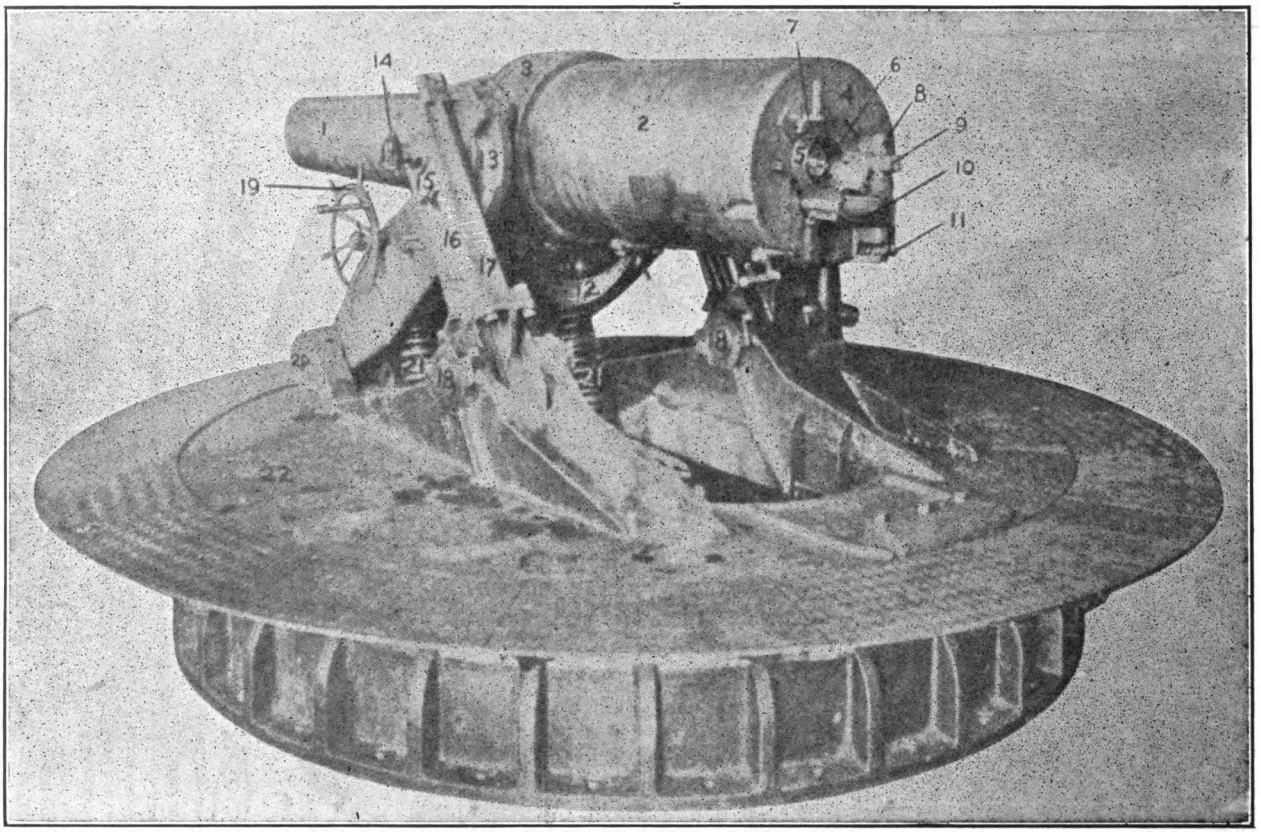
12-Inch Mortar, Model of 1912, Mounted on Mortar Carriage, Model of 1896 MIII

For cross section of carriage showing roller path, etc., see Ordnance Pamphlet No. 1920

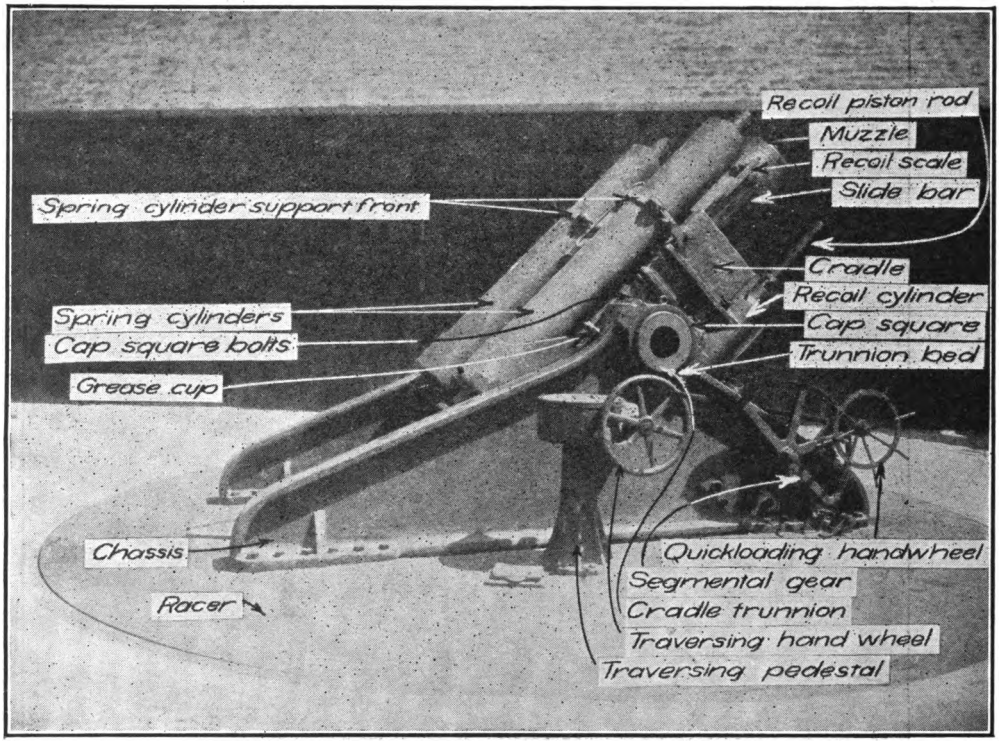
1 Chase hoop
2 Jacket
3 Trunnion hoop
12 Elevation rack
13 Top carriage
15 Cross head
16 Piston rod
17 Cross head guides
19 Elevating handwheel
20 Fulcrum pins
21 Counter recoil springs
22 Racer
23 Cap squares
24 Guide cap and balata buffer
25 Traversing handwheel
26 Worm box
27 Pedestal bracket
28 Lid (To protect azimuth pointer or subscale)



12-Inch Mortar, Model of 1912, Mounted on Mortar Carriage, Model of 1896 M1II

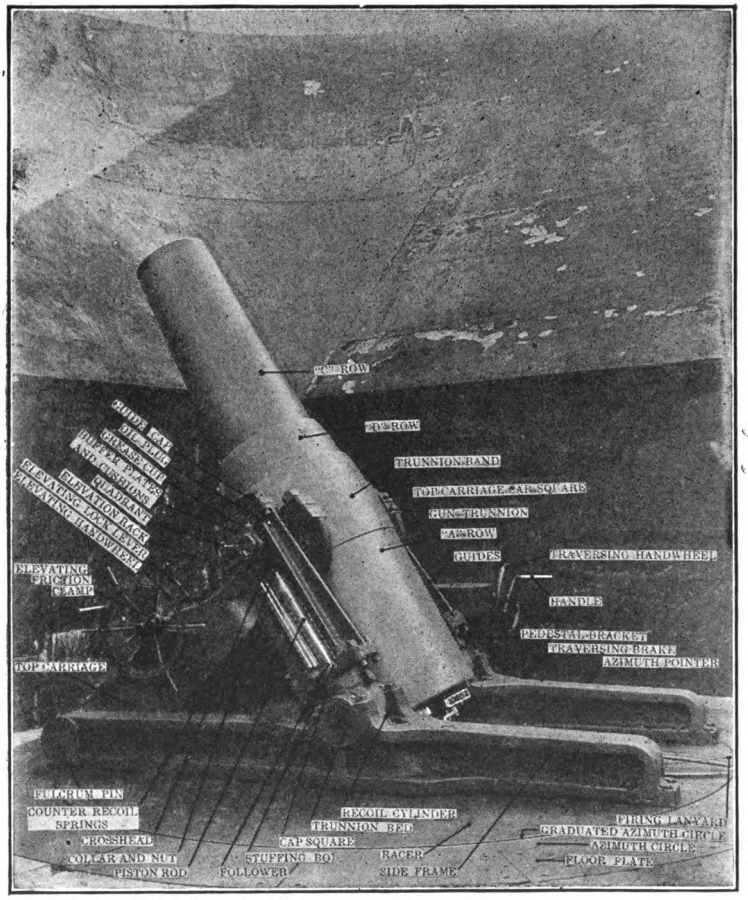
For cross section of carriage showing roller path, etc., see Ordnance Pamphlet No. 1820

1 Chase hoop
2 Jacket
3 Trunnion hoop
4 Breech bushing (screws into jacket and holds the breechblock)
5 Breechblock
6 Firing mechanism seat
7 Locking bolt
8 Hinge pin nut
9 Compound gear
10 Tray
11 Hinge pin
12 Elevating rack
13 Top Carriage
14 Quadrant
15 Cross head
16 Piston rod
17 Cross Head guide
18 Cylinder trunnion
19 Elevating handwheel
21 Counter-recoil springs
22 Racer



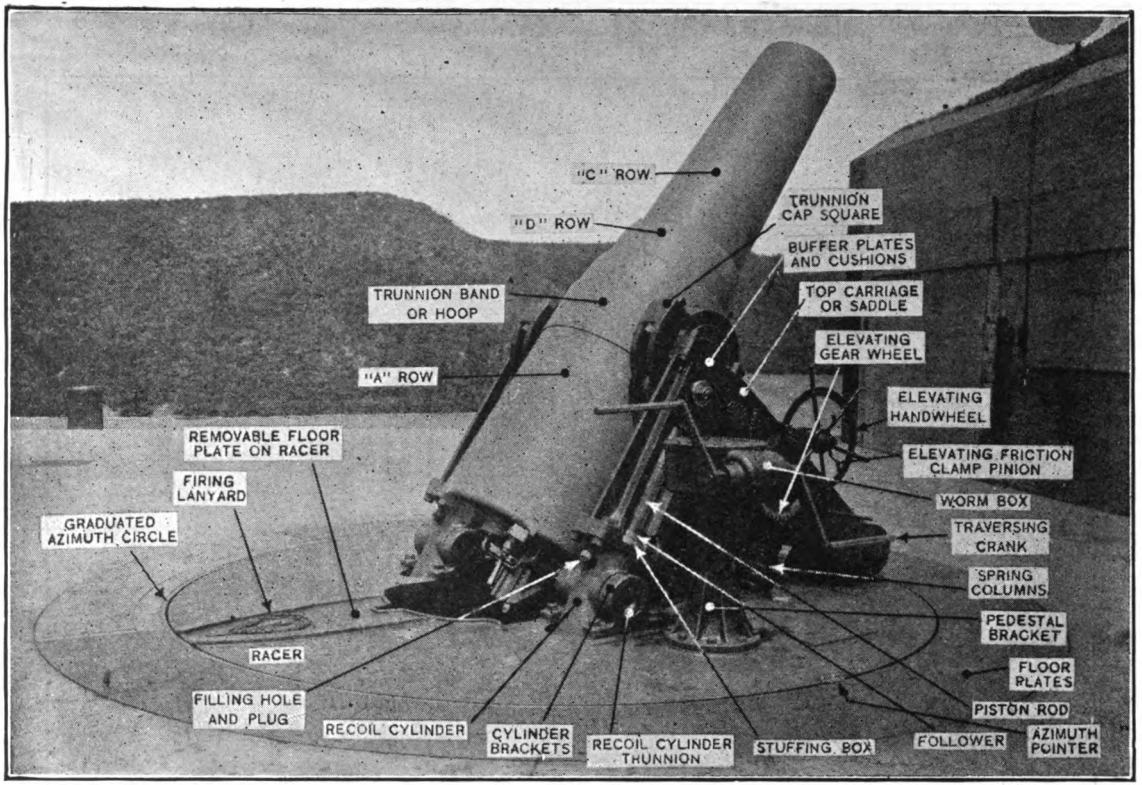
12-INCH MORTAR, MODEL 1908, MOUNTED ON 1908 CARRIAGE

FOR CROSS SECTION OF CARRIAGE SHOWING ROLLER PATH, ETC., SEE ORDNANCE PAMPHLET NO. 1702



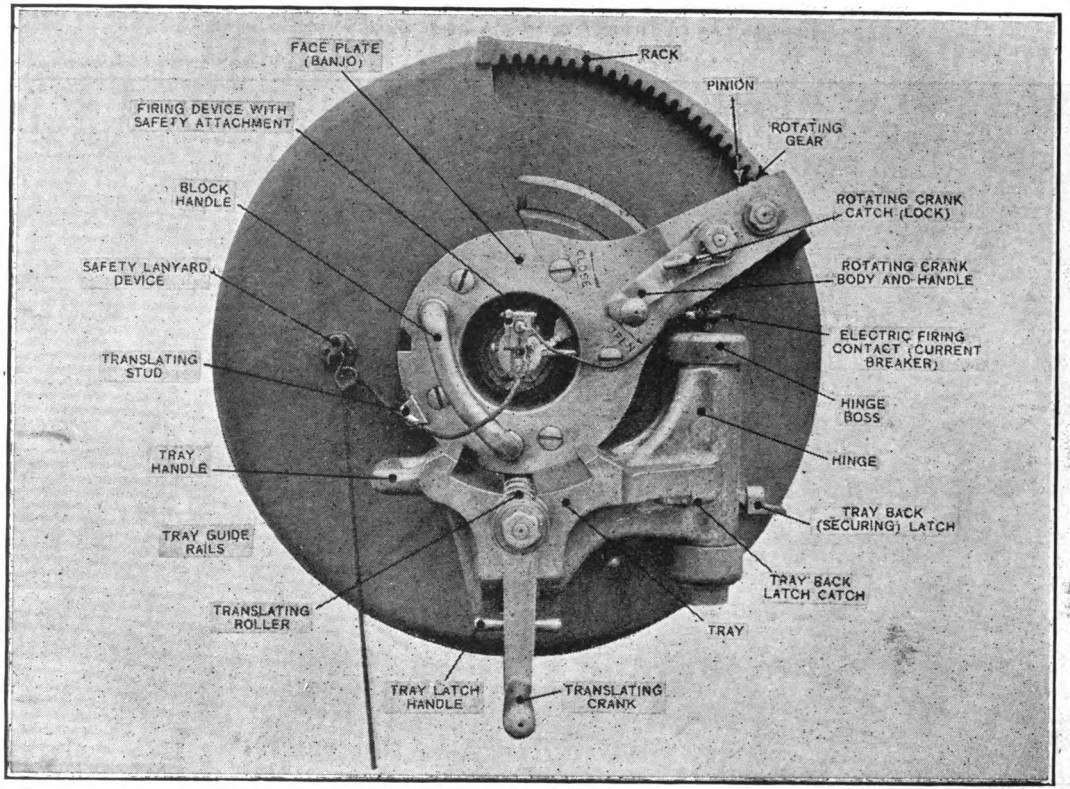
Department of Enlisted Specialists, C. A. S.

12-INCH STEEL MORTAR, MODEL 1890 MI, MOUNTED ON SPRING RETURN CARRIAGE, MODEL 1896 MI
FOR CROSS SECTION OF CARRIAGE SHOWING ROLLER PATH, ETC., SEE ORDNANCE PAMPHLET NO. 1705



From "The Service of Coast Artillery," Hines-Ward

12-INCH STEEL MORTOR, MODEL 1890 MI, MOUNTED ON SPRING RETURN CARRIAGE, MODEL 1896
FOR CROSS SECTION OF CARRIAGE SHOWING ROLLER PATH, ETC., SEE ORDNANCE PAMPHLET NO. 1705



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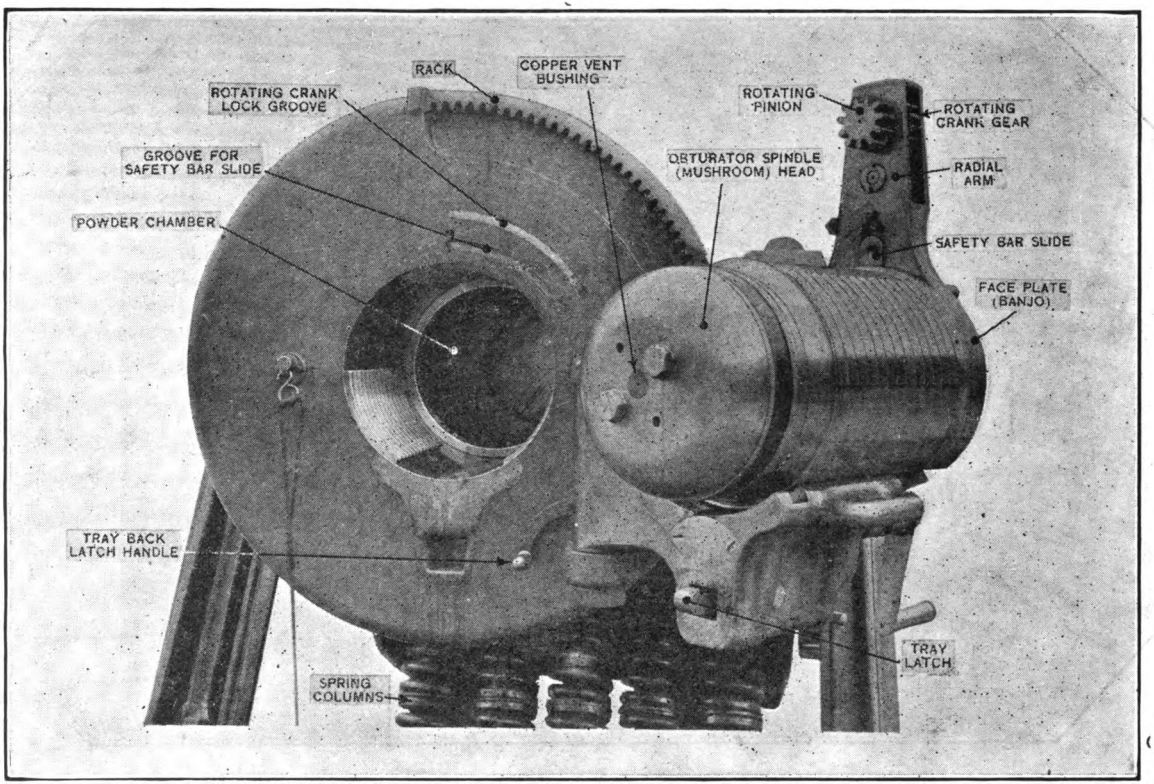
BREECH MECHANISM (BANJO TYPE). 12-INCH STEEL MORTAR, MODEL 1890 MI. (CLOSED)



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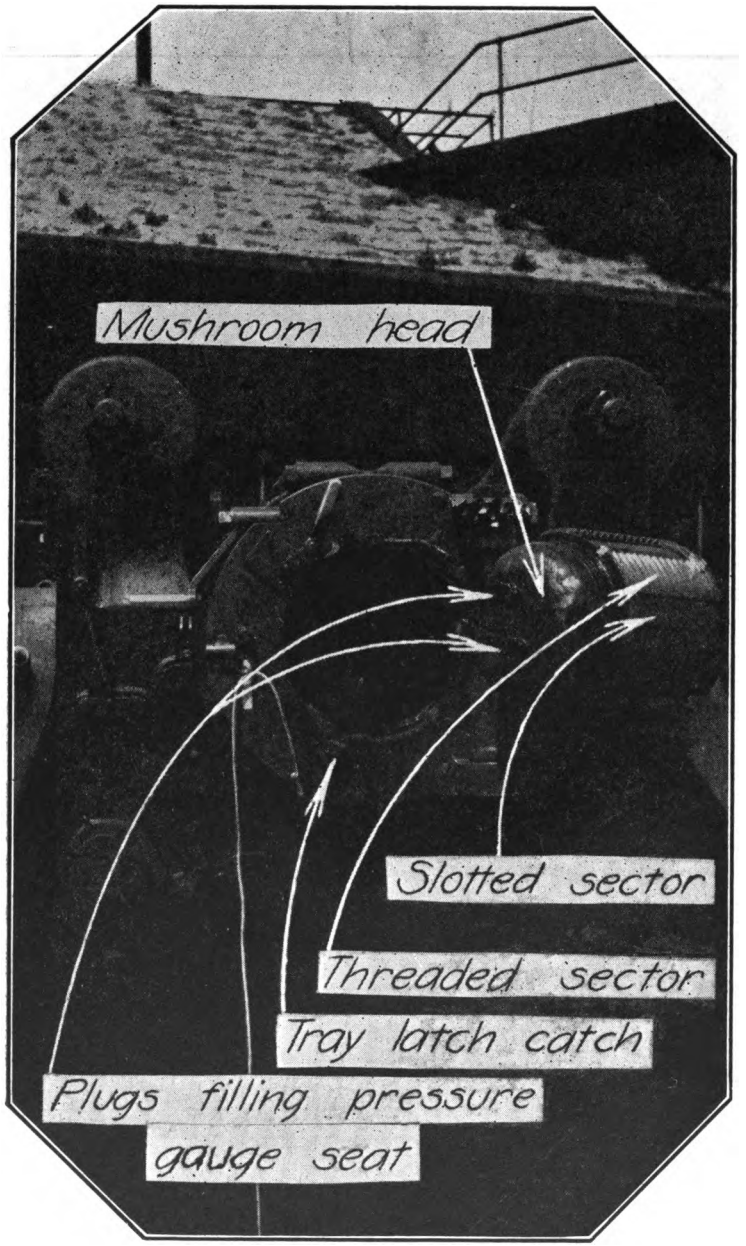
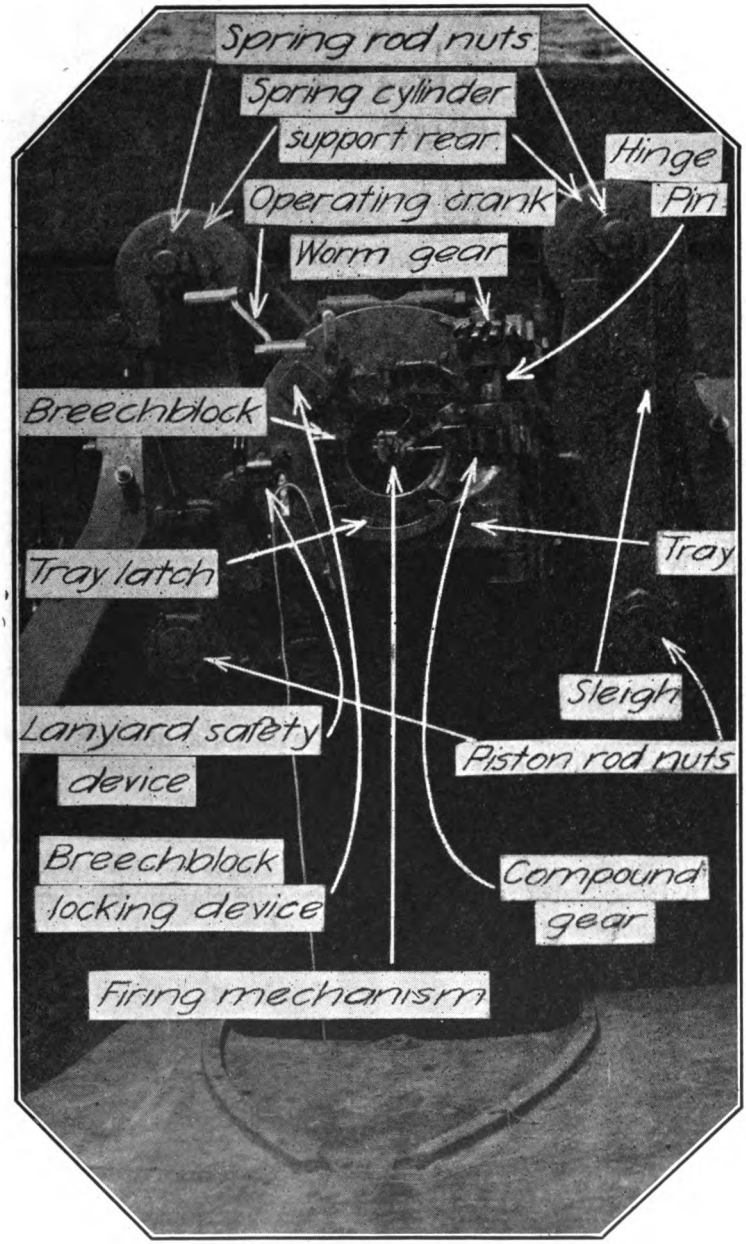
BREECH MECHANISM, (BANJO TYPE), 12-INCH STEEL MORTAR, MODEL 1890 MI. (OPEN)



BREECH MECHANISM, 12-INCH MORTAR, MODEL 1908. (OPEN)



BREECH MECHANISM, 12-INCH MORTAR, MODEL 1908 (CLOSED)

MORTAR COMPANIES

SECOND CLASS

(a) SERVICE OF THE PIECE

See Appendix "H"

(b) NOMENCLATURE OF THE VARIOUS PARTS OF MORTARS AND CARRIAGES

AND

(c) ACTION, ADJUSTMENT AND CARE OF THE VARIOUS PARTS OF MORTARS AND CARRIAGES

Q. What is the name of your battery?
Q. What model of mortar is mounted in it?
Q. What model of carriage is the mortar mounted upon?

MORTARS

Point out the following parts of 12-inch Mortar:

Breech.
Breech reinforce.
Trunnion hoop.
Trunnions.
Rimbases.
Chase.
Muzzle.
Breech mechanism.
Breechblock.
*Breechblock locking device.
*Safety-bar slide latch.
Breech recess.
Obturator.
Spindle.
Mushroom head.
Gas-check pad.
2 exterior split-rings.
1 interior split-ring.
1 filling-in-disc.
†Spindle washers.
*Obturator spindle spring
Spindle clamp nut.
Vent.
Firing mechanism.
Quadrant.
Bore.
Powder chamber.
Centering cone.
Forcing cone.
Main bore.
Gas-check seat.
†Rotating rack.
†Rotating pinion.

* Pertains to models 1908 and 1912 only.
† Pertains to models 1890 MI and earlier, only

†Block handle.
†Translating roller.
†Translating roller well.
*Operating worm and crank.
*Worm wheel.
*Locking bolt.
Tray.
Tray latch.
†Securing latch.
*Compound gear.
Guide rails.
Hinge.
Hinge pin.
Slotted sectors.
Lands.
Grooves.
†Hinge-pin oil hole.
*Handy oilers.

Q. What is the length and the weight of the 12-inch mortar?

A. Model 1890 MI: 12 cal. or ft.; 13 tons.
Model 1908: 10 cal. or ft.; 8 tons.
Model 1912: 15 cal. or ft.; 15 tons.

Q. How is the 12-inch mortar built?

A. The 1890 MI and earlier models are built up of *hoops* and (except the 1886 cast-iron mortar) a jacket, assembled over a tube.

The 1908 model is built up of a tube, steel wire wrapping, a jacket, and a trunnion hoop.

The 1912 model is built up of a tube, steel wire wrapping, a chase hoop, a jacket, and a trunnion hoop.

Q. Explain how a breechblock of a 12-inch mortar is dismantled.

A. Open breech, remove firing attachment. Remove spindle nut, withdrawing spindle from block by hand. Split rings, gas-check pad, and filling-in-disc may now be removed.

Q. How is it then assembled?

A. To assemble, proceed in reverse order. Firing attachment is not placed on spindle until the mushroom head has been adjusted.

Q. Explain how the mushroom head is adjusted for firing.

A. Close the breech with the spindle nut loose, but not loose enough to permit slipping of the pad or split rings. Rotate the block one-half. With the mechanism in this position screw up the spindle nut as tight as it can be screwed with the wrenches provided.

With the new spindle nut having a locking device it is necessary to insert the end of a screwdriver in the opening of the nut in order to spread it sufficiently to allow its rotation without rotating the spindle. Tighten the clamping screw on

* Pertains to models 1908 and 1912 only.
† Pertains to models 1890 MI and earlier, only.

the spindle nut and rotate the breechblock until the breech is completely closed. Then the pad should be in proper adjustment for firing; this may be tested by turning the mushroom head by hand. It should turn easily, but without play.

CARRIAGES

Point out the following parts of the mortar carriage:

Azimuth circle.
Azimuth pointer.
Base ring.
Upper roller path.
Conical rollers.
Lower roller path.
Pintle.
Traversing rack.
Traversing handle.
Traversing worm shaft.
Trunnion bed.
Cap squares.
Racer.
Fulcrum.
Top carriage.
†Side frames.
*Chassis.
†Web.
*Transom.
Packing ring followers.
Elevating mechanism.
*Quick loading mechanism.
Cap-square bolts.
Recoil cylinders.
Piston and piston rod.
†Crossheads.
†Crosshead guides.
†Cap and buffer.
Traversing vertical shaft.
Conical rollers.
Distance ring.
Dust guard.
Oil holes.
Floor plates.
Guide rails.
Equalizing pipes.
Counter recoil springs.
Spring rods.
†Spring caps.
*Spring cylinders.

Q. How is the old packing removed from the stuffing box?

A. First, draw all the oil from the cylinders, then with spanner wrench remove the follower and the gland. Remove the old rings of the packing, using the extractor. Examine the old packing and throw away any not fit for use. If any of the old packing is to be used, it should be put in after the new packing.

Q. How is a stuffing box repacked and adjusted?

A. Put on the piston one ring of Garlock's waterproof hydraulic packing and force it well to the bottom of the stuffing box with a wooden stick and mallet. Treat each layer the same, being careful to break joints, until six rings of new packing have been inserted, or an equal amount of old and new packing, if any of the latter has been used. Place the

* Pertains to 1908 model only.
† Pertains to 1896 model only.

halves of the gland on the follower, being careful that the halves of the glands do not bind on the screw threads. No more force should be used on the spanner wrench than that of two men, *not using a pipe or any other extension of the wrench handle;* generally, that of one man is sufficient. After the box is adjusted, there should be not more than one inch between the flange of the follower and the part into which it is screwed.

Q. How are the recoil cylinders filled?

A. Remove filling plugs of both cylinders and fill till they overflow, then replace plugs.*

Q. What kind of oil is used in the cylinders and how much?

A. Hydrolene, about 10½ gallons.

Q. What is the equalizing pipe?

A. A pipe connecting the lower ends of the two cylinders.

Q. Why is it necessary?

A. To keep the pressure during recoil the same in both cylinders and thus keep the carriage from jamming, by having the same amount of oil in both cylinders.

Q. How is the recoil taken up?

A. By resistance which the oil in the cylinders offers to the passage of the piston head; but a small part is taken up in compressing the counter-recoil springs.

NOTE.—In model 1896 carriages, the plugs formerly used in the cylinders have all been removed and all the holes are now open. In the model 1896 MI carriages, all these holes have been closed and three throttling grooves cut in the cylinder. In the model 1896 MII and MIII and in the model 1908 carriages, the cylinders have the three throttling grooves and are cast without any by-pass.

Q. How is the carriage cared for?

A. All parts must be kept clean and free from rust. Rust on the piston rods must not be removed with sand paper, but with kerosene or Emory No. 1. Especial attention must be given to the following parts:

Gun trunnions, rollers, pintle surfaces, shaft bearings, all sliding surfaces, bearings, crosshead pieces, elevating racks, cross head guides, and all elevating mechanisms. Traversing rollers and their paths must be kept clean and well oiled.

Q.† What is used as a lubricant for translating rollers?

A.† No. 4½ lubricant and graphite.

* With the 1908 model carriage, the cradle should be elevated to about 10° to avoid air cushions.

† Pertains to mortars models 1890 MI and earlier only.

Q. What kind of oil should be used as a lubricant on breech mechanism, threads of breechblock, breech recess, and gears, and in all oil holes?

A. Engine oil No. 1.

Q. How much oil should be used?

A. Simply enough to cover the surface with a thin coating, rubbed over with the hand. Too much oil is to be avoided; but, when firing the guns, use plenty on the breechblock and in breech recess.

Q. What kind of oil should be used in bores of guns and as a lubricant for traversing rollers and their paths?

A. Light slushing oil, when fresh.

Q. What other lubricant may be used for traversing rollers?

A. A mixture of engine oil No. 1 and graphite, if light slushing oil is not satisfactory.

Q. What kind of oil will be used as a preservative in case the guns remain unused for a considerable time?

A. Light slushing oil.

Q. How is light slushing oil applied?

A. By means of paint brushes in a light thin coat.

Q. How can light slushing oil be removed?

A. By means of waste or burlap dipped in kerosene oil. Old hydrolene also is suitable.

Q. How is the bore cleaned after firing?

A. By use of water. The bore should be permitted to drain and be wiped dry before applying light slushing oil (See paragraph 440, Appendix "B.")

Q. Explain the adjustment of the grease cups.

A. Be careful that no grit or dirt gets into them. Fill them with Lubricant 4½ to the bottom of the bevel at the top of the cup. In putting on the cap be sure that the leather-packed follower enters the cup properly and is not caught or bent. Screw the cap down until the spring rod projects about ¼ of an inch above the head of the cap.

Q. How can you tell when the cup is ready to be refilled?

A. When the cap is screwed well down and the spring rod does not project.

Q. Explain how to attach and adjust the firing mechanism.

A. Clasp the hinged collar about the spindle; slip the safety bar into the notch of the housing, hold the housing over the hinged collar and screw the latter into the housing until the spring catch engages While doing this, see that the guide

bar enters the groove in the breechblock and the pin of the safety bar slide enters the hole of the safety bar.

Put the ejector in place with the ejector raised and the slide stop pulled out. Place the slide in position.

Q. Take off and put on the firing mechanism.

NOTE.—To avoid accident through a premature explosion, the greatest care must be taken of the firing mechanism.

It should be frequently inspected and tested with an unfired service primer and must always be so tested before service practice. To test, insert an unfired service primer and rotate the breechblock slowly and completely to its firing position, having, during this rotation, a strong steady pull on the lanyard sufficient to fire the primer.

Should the primer fire, report the fact at once to the battery commander.

POWDERS, PROJECTILES, FUSES AND PRIMERS

POWDERS

Q. What kind of powder is used in the 12-inch mortar?

A. Smokeless, nitrocellulose.

Q. What is nitrocellulose?

A. It is nitrated cotton. That is, it is what results when dry cotton is immersed in nitric acid. Water, also, is formed. Sulphuric acid absorbs water. Sulphuric acid is used in the mixture to absorb the water formed and keep the nitric acid from being diluted.

Q. What are the next steps in making nitrocellulose powder?

A. 1. Washing excess acid from the nitrocellulose;
2. Dissolving the nitrocellulose in a mixture of alcohol and ether;
3. Compressing the material after evaporating the alcohol and ether;
4. Rolling it into sheets or pressing it into rods or tubes;
5. Cutting up the sheets, rods, or tubes into grains;
6. Drying the grains.

Q. What is the form of its grains?

A. Perforated cylinder.

Q. What is *Combustion*, *Ignition*, *Inflammation*, *Explosion*?

Combustion is the burning of a grain of powder, or wood, or coal, from the surface of ignition inward or outward or both.

Ignition is the setting on fire of a part of the grain or charge.

Inflammation is the spread of the ignition from point to point of the grain, or from grain to grain of the charge.

Explosion is rapid combustion. It is the rapid conversion of gunpowder into gases and solids. (When this conversion is very rapid and accompanied by a crushing or shattering effect, it is called *detonation*.)

Q. What is the object of the igniting charge?

A. To secure a quicker ignition of the smokeless powder.

Q. Where is the igniting charge located?

A. An igniter, or igniting charge, is quilted in each end of each charge, and is also placed in the cloth tube connecting

the ends. This tube filled with black powder is called a core igniter.

Q. What kind of powder is used as igniting charge?
A. Black powder.

Q. How is powder stored?
A. In hermetically sealed cases in magazines.

Q. What is the weight of a charge of powder?
A. This varies with the zone, from about 25 pounds for the 1st zone to about 55 pounds for the 9th zone.

Q. How many zones are there?
A. For the steel mortar, eight or nine. For the cast-iron, seven. For the model 1912 mortar, eleven, the first eight (1 to 8a inclusive) for 1046 and the outer three (8b to 10) for the 700 pound projectile.

Q. What is the velocity in each zone?
A. For Steel Mortar, Models 1890 and 1890 MI:

Zone	Projectile	Velocity, f.s.
1	1046	550
2	1046	600
3	1046	660
4	1046	725
5	1046	810
6	1046	915
7	1046	1050
8*	824	1300
	700	1250
9	700	1500

For the Model 1912, the first seven zones are as above but the last four are as follows:

Zone	Projectile	Velocity, f.s.
8-a	1046	1200
8-b	700	1250
9	700	1500
10	700	1800

(For C. I. Mortar, See Appendix "E.")

Q. What are the ranges for mortars?
A. For the steel mortar, from about 2200 to about 15,300 yards. For the cast-iron mortar, from about 2200 to about

* In batteries in which provision is made for the 9th zone, the 700-lb. projectile is used in the 8th; in other batteries, the 824-lb. projectile is used in the 8th.

9200 yards. For the Model 1912, from about 2200 to about 19,300 yards.

PROJECTILES

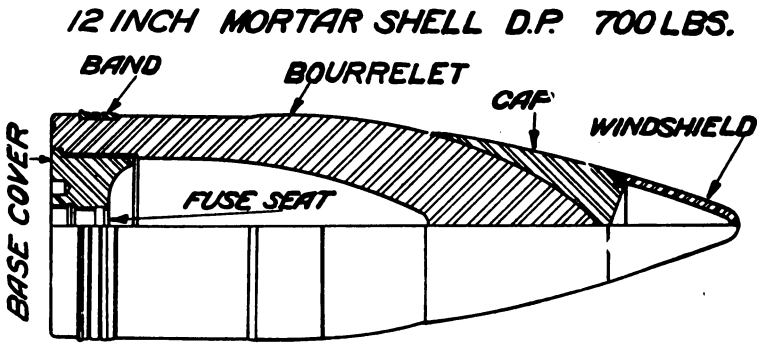
Q. What projectiles are used in mortars?

A. Capped D. P. shell and torpedo shell. Shot are not used with mortars. Cast-iron projectiles are used for target practice.

Q. What is the weight of a 12-inch mortar projectile?

A. 700, 824, or 1046 pounds.

Q. Using diagram of a projectile, point out the following: The ballistic cap, the armor piercing cap, the ogive, the bourrelet, the body, the base, the rotating band, the fuse plug.



Q. How should projectiles be piled?

A. Projectiles will always be piled on skids, with no weight resting on rotating bands, with point to the wall and base out, so they may be easily inspected and fused in case of necessity.

Projectiles for target practice must never be piled with those intended for service.

Projectiles will be painted as required by regulations, and in case the galleries are wet, the projectiles after painting will be slushed. Skids or strips of wood should be placed between layers, and every care taken to prevent injury to rotating bands.

Q. What is the weight of the subcaliber projectile for mortars?

A. 18 lbs.

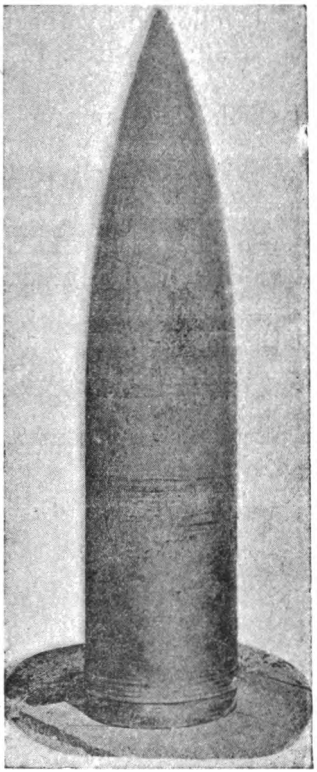
Q. Why does it differ in weight from that for guns?

A. To give larger splash and thus be more readily seen.

Q. What is the name of the explosive used in all our armor piercing projectiles?

A. Explosive D.

Q. What is the appearance of Explosive D?
A. It is a dark yellow, or orange color, powder.
Q. How is it loaded in the projectile?
A. By hand, using suitable ramming tools.



12-INCH SHELL WITH NEW MODEL LONG POINTED CAP

12-INCH SHELL WITH OLD MODEL CAP

Q. What does the color of a projectile indicate?
A. The bursting charge. Yellow indicates high explosive; Red, shrapnel; Black, solid shot or sand loaded shell (target practice projectiles).
Q. How is smoke mixture indicated?
A. By a green band ½ inch wide above the bourrelet.
Q. How is semi-steel indicated?
A. By a red band ½ inch wide above the bourrelet (and below the green band if there is one).
Q. What colors are used for stencilling?
A. Black, except that white is used for black surfaces.

Q. What is stencilled on the ogive of A.P. steel shot and shell for guns of 6-inch and greater caliber?

A. *1st line.* Exact weight of loaded shell, as "108."

2nd line. Caliber and type of gun, as "6 S C G."

3rd line. Kind of explosive, using the abbreviation TNT for Trinitrotoluol, Am. for Amatol, followed by the percentage of mixture, as 80/20 or 50/50; and exp. D, for Explosive D.

4th line. Lot number of filled shell. The ammunition lot number.

Q. What is stencilled on the center of gravity of A.P. shot and shell for guns of 6-inch and greater caliber?

A. Description of shell, as "Armor Piercing shell Mk. III."

Q. What information is stencilled on T.P. (target practice) projectiles?

A. (a) Exact weight, stencilled on the ogive.

(b) Caliber and type of gun, as "6 SCG," stencilled on the ogive.

(c) Description of projectile, stencilled on center of gravity, as "Target Practice Cast Iron Shot."

Q. What information is stamped on the base of projectiles?

A. (a) Caliber and type of gun and mortar.

(b) Kind of shot or shell.

(c) Lot number of unfilled shell.

(d) Weight of shell (unfilled).

(e) Name or initials of machining plant.

(f) Inspection stamps.

A sample marking would be: 12" Mortar D.P.shell 700 MkIII.
Lot 2-12, Bethlehem Steel Co. P.D.V.
Insp. N.S.K.

Q. What information concerning fuses is stamped on the rotating band at the time of manufacture?

A. The mark number and type of fuse to be used, as: "Mk III—Maj. Cal. Fuse." (The letter G or M indicates whether fuse is armed for gun or mortar projectile).

Q. What indicates that the projectile is not fused?

A. Four vertical black stripes 2 inches wide extending from rotating band to base of shell and equally spaced.

Q. What is stencilled on the base cover of a fused projectile?

A. The amount of delay action of the fuse, as "Non-Delay," "Short-Delay," or "Long-Delay," or equivalent initials.

Q. What indicates a projectile which is neither filled nor fused?

A. The word "Empty" stencilled in large letters lengthwise on the projectile.

FUSES*

Q. What is a fuse?

A. A fuse is the device used to ignite the bursting charge of a projectile at any point of its flight, or upon impact.

Q. What is the difference in purpose between a fuse and a primer?

A. A fuse ignites the bursting charge in the projectile; a primer ignites the propelling charge in the gun or mortar.

Q. How are fuses classified, according to their types?

A. According to construction:

Ring resistance.
Combination time and percussion.
Centrifugal.
Detonating.

According to location in the projectile:

Point.
Base.

Q. Which class is used in deck piercing projectiles?

A. The base detonating fuse.

Q. What base detonating fuses are used in deck piercing projectiles?

A. (1) The major caliber base detonating fuse; (2) the armor piercing base detonating fuse.

Q. Of these two which is the latest model?

A. The major caliber base detonating fuse. (See "Fuze Board, Frankford Arsenal, 1912.")

Q. What is intended as to future supply of the other?

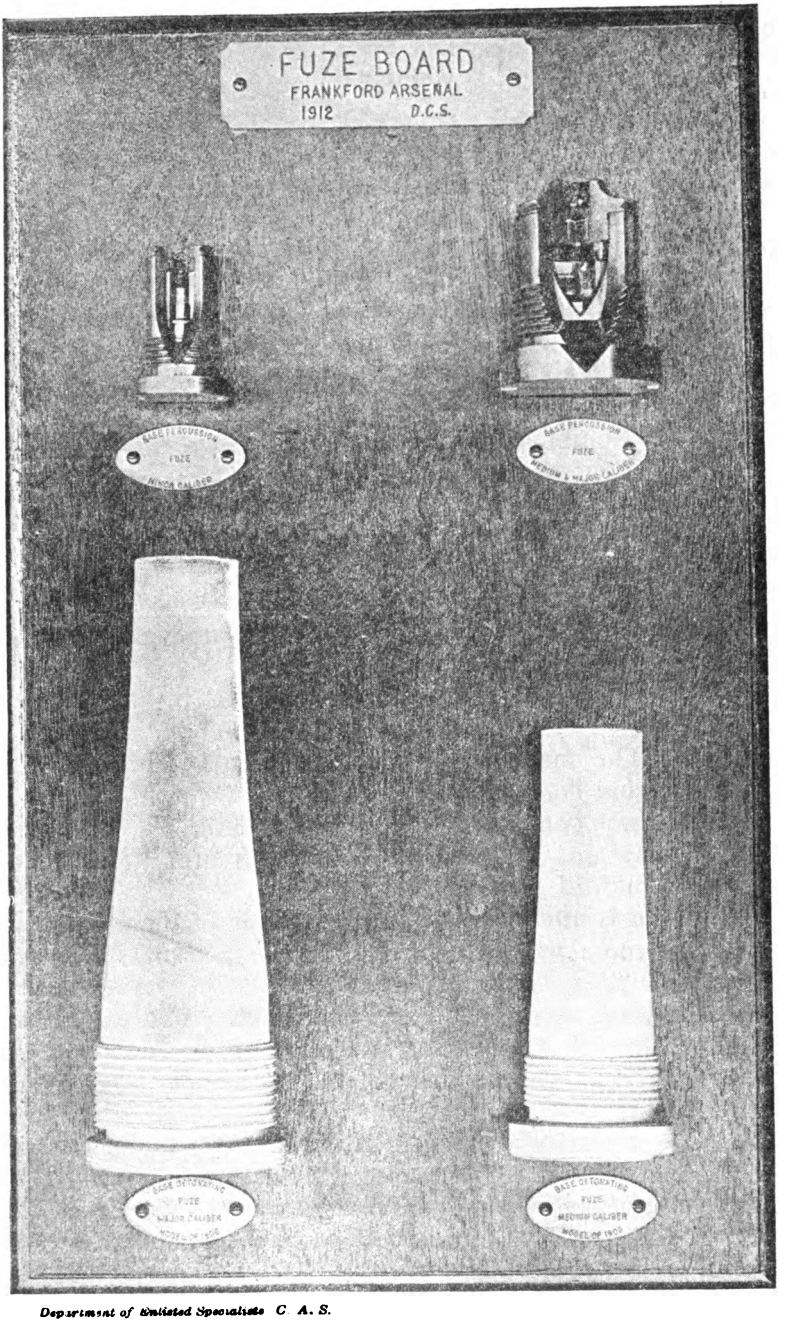
A. No more will be issued after the present supply has been used up.

Q. In what respect do the major caliber base detonating fuse and the A.P. detonating fuse used in the A.P. shot and shell for guns differ from those of the same types used in D.P. shell for mortars?

A. The centrifugal plungers of the fuses for use in guns are designed to arm at 2000 revolutions per minute, while those for use in mortars are designed to arm at 1300 r.p.m.

Q. What are the lengths of the two base detonating fuses used in mortar projectiles?

* See Ordnance pamphlet No. 1727 (latest revision, 1913); also see "Fuze Board, Frankford Arsenal, 1912."



Department of Enlisted Specialists C. A. S.

A. (1) The major caliber base detonating fuse, 6.7 inches; (2) the armor piercing base detonating fuse, 9.5 inches.

Q. How can the two fuses be distinguished by the appearances of their bases?

A. The major caliber b.d.f. has a small plug flush with the base, the plug being provided with holes for tit-wrench.

The A.P. base detonating fuses have a set-in plug with flat surfaces to be gripped by wrench.

Q. Name the fuses used in your battery.

Q. How do you make a tight joint in assembling a fuse in a projectile?

A. Vaseline is placed in the threads of the fuse hole and on the threads of the fuse, which is screwed up tight. As an additional precaution a base cover is added.

NOTE.—The work of inserting fuses in projectiles is exceedingly dangerous and should be done strictly in accordance with "Instructions for loading projectiles." (See Appendix "F.")

PRIMERS*

Q. What is a primer?

A. A primer is a device used to ignite the powder charge in the gun.

Q. Name the classes of primers.

A. 1. Drill.
2. Simple electric.
3. Friction.
4. Combination electric-friction.
5. Percussion.
6. Igniting.

Q. What primers do you use at your battery?

A. Drill primer, friction, simple electric, combination electric-friction primer, and 110-grain igniting primer.

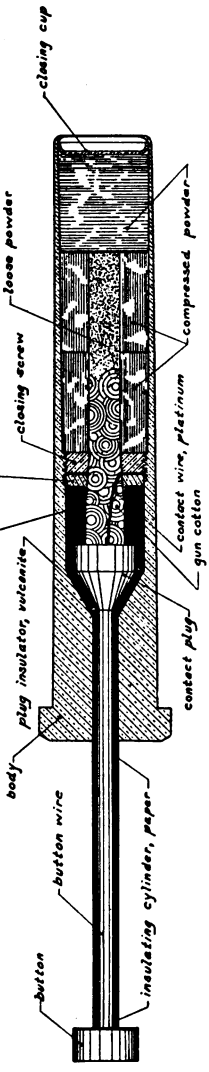
Q. When is each used?

A. The drill primer is used in drill and in sub-caliber practice; the simple electric primer in service practice and in action; the friction primer is for emergency use in cases where the electric primer fails to function; the combination electric-friction primer in subcaliber practice; and the 110-grain igniting primer in the base of the cartridge cases for subcaliber practice with the 18-pounder subcaliber guns only.

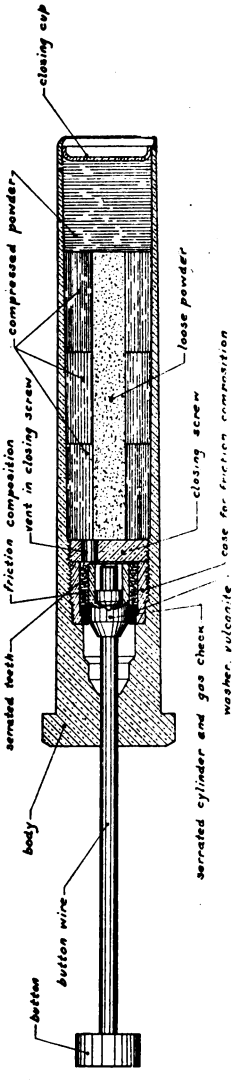
Q. Where is the percussion primer used?

* See Ordnance pamphlet No. 1881 (latest revision, 1915); see also "Primer Board, Frankford Arsenal, 1912."

ELECTRIC PRIMER

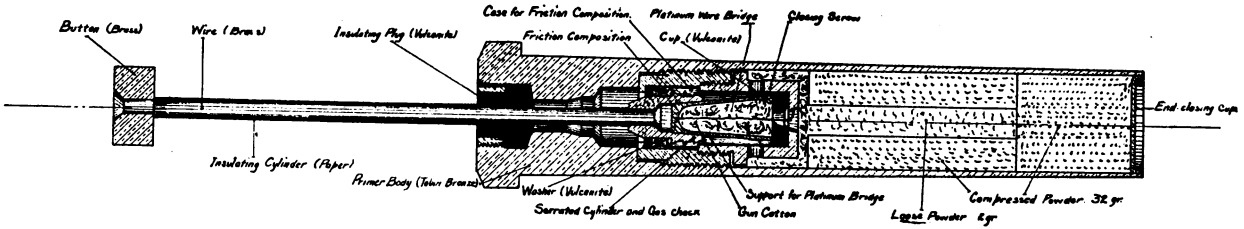


FRICTION PRIMER



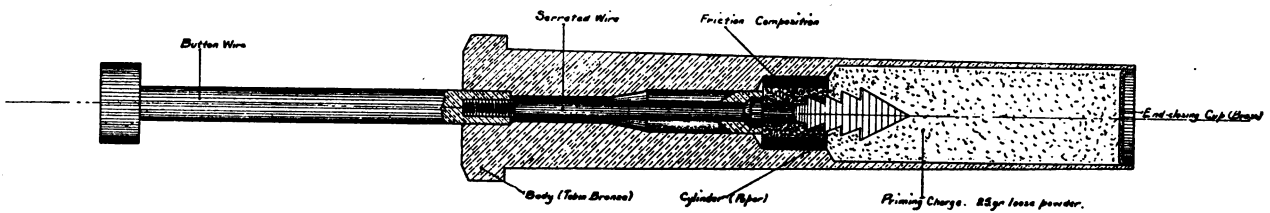
COMBINATION - PRIMER

ELECTRIC - FRICTION



DRILL - PRIMER

- FRICTION -



A. In fixed ammunition, such as for small arms and the 3-inch gun.

Q. Why are drill primers furnished in addition to combination primers and friction primers Model 1914?

A. The drill primer is much cheaper and can be loaded at post.

CORDAGE, BLOCKS, GINS, SHEARS, AND JACKS

CORDAGE

Q. Define yarn, strands, jaws of a rope.

A. A yarn is a thread of hemp or other fibrous material.

A strand is a number of yarns twisted together.

The jaws are the spaces between the strands of a rope.

Q. Make a square knot; bowline; anchor knot; rolling hitch; blackwall hitch; round turn and two half hitches; clove hitch; long splice; short splice. Explain the use of each.

A. Square knot, for joining the ends of two ropes of the same size. (Note.—If the pull is on diagonal corners, this knot readily slips and is called a *thief knot.*)

Bowline, for forming a loop at the end of a rope which will neither draw up, become loose, nor jam when wet or under heavy strain.

Anchor knot, for fastening a rope to an anchor or ring. It will neither draw up, become loose, nor jam when wet or under a heavy strain.

Rolling hitch, for fastening a rope to a strap or tail block, and to secure a fall while being shifted on a windlass or capstan.

Blackwall hitch, for fastening a rope to the hook of a block. Round turn and two half hitches, to secure guys to stakes. Clove hitch, for fastening a rope to a spar.

Long splice, for splicing a rope without increasing its diameter at the place of splice.

Short splice, for splicing a rope allowing an increase in diameter at the place of splice.

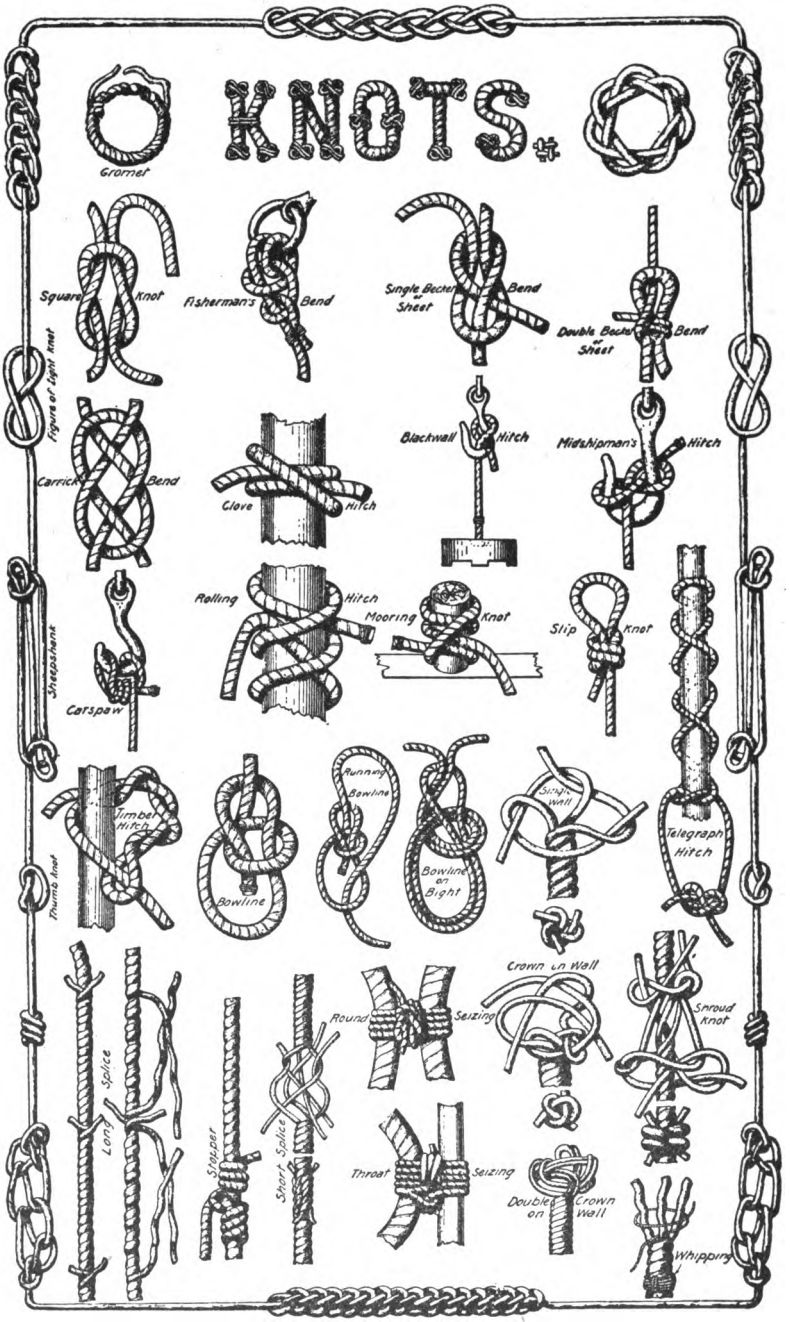
Q. How is rope stored?

A. Rope should be stored in a dry cool place and in such a manner as to allow a free circulation of air through its coils.

Q. After being used, how is rope treated before storing?

A. It should be thoroughly dried, carefully examined for any evidence of chafing or deterioration, and, if practicable, all sections dangerously weakened should be cut out and the rope spliced at these places.

Q. What is whipping?



A. Wrapping the end of a rope with twine to prevent its unraveling.

Q. What is splicing?

A. Joining the ends of ropes by intertwining the strands.

Q. What is worming?

A. Filling the jaws of a rope by laying spun yarn or marline along them, to render the surface smooth for parceling and serving.

Q. What is parceling?

A. Wrapping (with the lay of the rope) with narrow strips of canvas so as to protect a rope.

Q. How do you serve a rope?

A. By worming, then parceling, and finally laying on spun yarn or other small stuff around the rope in turns close together against the lay of the rope.

Q. What is a strap, or sling, and for what is it used?

A. It is formed by knotting or splicing together the ends of a short rope. It is used for hooking tackles into.

Q. Mouse a hook and explain its purpose.

A. It is seizing placed around the jaw of a hook to prevent it from spreading or unhooking.

BLOCKS

Q. Name the different parts of a block and point them out.

A. Shell, sheave, pin, strap, eye, thimble, hook, bolt.

Q. Mention the different kinds of blocks.

A. Single, double, treble, snatch, and tail blocks.

Q. What is a purchase?

A. A purchase in cordage is a tackle of any kind for giving power.

Q. What is a tackle?

A. It is a purchase formed by rigging a rope through one or more blocks.

Q. Point out the running part, the standing part, and the fall.

Q. Reeve the following: Whip, gun tackle, luff.

A. See illustration (page 34).

Q. What is meant by the power of a tackle?

A. The number obtained by dividing the weight raised by the force applied on the fall necessary to balance the weight. In an ordinary tackle the number of ropes pulling upon the movable block is the "power."

Q. Examine a triplex block and explain its use.

A. A triplex block is a device used to lift a heavy weight with the use of a small amount of power.

For many purposes it is much better than any form of tackle.

It consists of a train of gears operated by a large wheel over which passes a light chain. Power is applied to this chain. The gears operate a small wheel or sprocket, over which runs a heavy chain. The heavy chain raises the weight. A hook is bolted to one side of the casing for attaching the block to a crane or davit.

WHIP TACKLE

GUN TACKLE

LUFF TACKLE

GINS

Q. Describe a gin.

A. A gin is a tripod formed of three poles. The two outside ones are called legs, the third one the pry pole. A gin requires no guys.

Q. What is it used for?

A. For lifting weights *vertically*.

Q. Name the different parts of a garrison gin.

A. Two legs, pry pole, bolt and clevis, windlass and ratchet, two hand spikes, three shoes, two braces, and tackle.

Q. How much can be safely lifted with it?

A. 17,000 pounds.

Q. Explain briefly how it is assembled and raised.

A. The legs and pry pole are laid on the ground with the heads together and in position for assembling.

The head is then assembled by putting the pin through the pry pole, clevis, and legs. The windlass is put in place and the braces are brought up and put in their places.

The gin is raised, after being put together, by raising the head and bringing up the foot of the pry pole towards the feet of the other two legs.

Q. How can the upper block be placed in position after the gin has been raised?

A. By rigging a trace rope through the clevis of the gin and shell of the block and hoisting it up.

Q. What are the principal uses of the garrison gin?

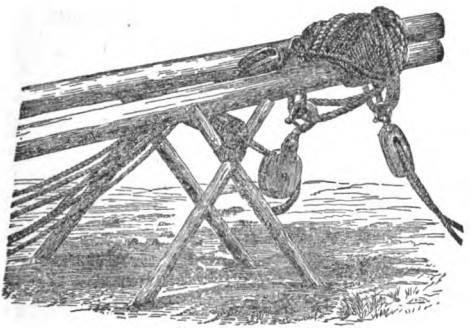
A. For lifting vertically any weights within its capacity. It is designed especially for use around the gun and mortar emplacements.

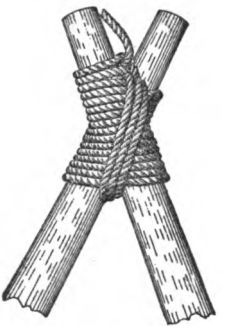
SHEARS

Q. Describe shears.

A. Shears consist of two spars, of a size suitable for the weight to be raised, lashed together at the cross. A tackle is fastened to the lashing by a strap or otherwise; the hook is moused; and holdfasts are required.

Q. What are shears used for?





SHEAR LASHING
(SEE ENGINEER FIELD MANUAL, FIGS. 78 AND 79.)

A. Shears are used for lifting heavy weights to move them a short distance, as in loading or unloading a ship or railroad car.

Q. How is a shear lashing made?

A. The two spars for the shears are laid along side of each other with their butts on the ground, the points below where the lashing is to be resting on a skid. A clove hitch is made around one spar and the lashing is taken loosely eight or nine times about the spars above it without riding. A couple of frapping turns are then taken between the spars and the lashing is finished off with a clove hitch above the turns on one of the spars. The butts of the spars are then separated, a sling (or strap) is passed over the fork, to which the block is hooked or lashed, and fore and rear guys are made fast with clove hitches to both spars just above the fork.

Prepare the holdfasts for the foot ropes, to prevent the heels from slipping while raising, and for the guy ropes when the shears are ready for raising.

Q. How are shears held in position after being raised?

A. By means of guys.

Q. How are the shears raised?

A. If not too heavy, lift the head and haul in on the proper guys. If too heavy to raise in this way, form a crutch by lashing together two poles near their upper ends, the feet of the crutch being slightly in rear of the heels of the shears and secured to prevent them from slipping. Lay the rear guy over the crutch and raise the crutch by means of two light guy ropes, until it is inclined at an angle of about 45° to the front. Haul on the rear shear guy, allowing the crutch to rise as the shears rise. After the shears are raised high enough so that the crutch ceases to act, it is lowered by means of its guy ropes.

HYDRAULIC JACKS

Q. For what is a hydraulic jack used?

A. For lifting heavy weights.

Q. What liquids are used in the jack?

A. Alcohol (*not wood alcohol*) one part and water two parts, for the base jack; and for the horizontal jack, one part of alcohol and one part of water.

In each case a tablespoonful of sperm oil is added.

Q. How is the jack filled?

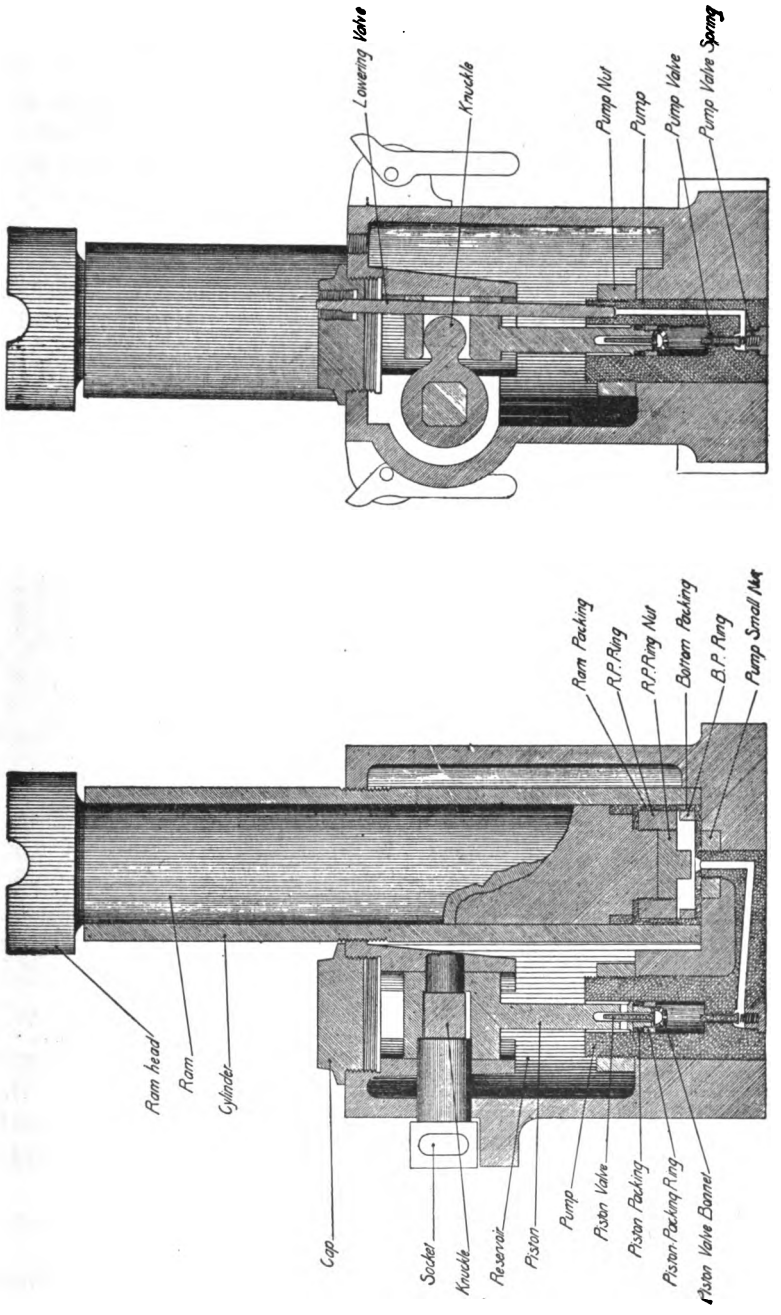
A. After cleaning, fill through the large hole, replace hexagonal cap, and then the lowering valve. In case it is necessary to add a little liquid to replace that which has leaked out, and at the place of work, remove small screw, fill, and replace the screw. This is to prevent sand from entering the pump mechanism. The ram should be down in both operations.

Q. How is the jack emptied?

A. With the ram down, place the finger over the escape hole in the cylinder, pump the ram until the bottom of it is above the hole, then open lowering valve, remove the finger, and allow the air to enter under the ram. The ram can now be easily pulled out.

Remove the lowering valve and hexagonal cap and invert jack to allow liquid to run out.

NOTE.—If the jack has lowering valve near bottom, only the cap need be removed.



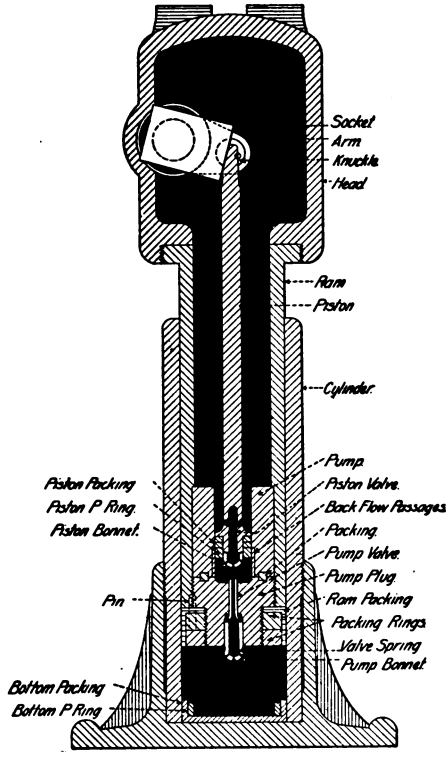
HORIZONTAL JACK.

Caution.—Always insert the lever in the socket with the projection down.

Q. How is a jack cared for when not in use?

A. The jack should always be kept filled and clean and free from rust. The ram should be kept down. Never fill with water, kerosene, or wood alcohol, which cause it to rust.

Q. Show how a jack is used in moving a heavy weight.



BASE JACK

A. See that the bottom of the jack has a firm bearing surface, and that the top of the ram presses securely against the weight to be moved. Tighten the lowering valve, and work the handle with a slow, steady stroke, and follow the weight up closely with the blocking.

Q. What is the difference, if any, in the use of a base and a horizontal jack?

A. A horizontal jack may be used equally well in a horizontal or an upright position. A base jack may be used standing or at an angle, with the limitation that the head

must be a little higher than the foot, so that the pump will be always submerged.

Q. How is a heavy weight lowered with a jack?

A. Care must be taken not to let the ram down too fast nor to check it too suddenly. Loosen lowering valve very slowly, bearing in mind that to avoid accident the weight must be "followed down" with blocking.

Q. How is a claw used with a jack?

A. When it is impossible to get the head of the jack under the weight, a claw is used. One end is placed under the object to be raised and the other end of the claw over the head of the jack.

U. S. MAGAZINE RIFLE

Q. Point out the following parts:

Barrel.	Firing pin sleeve.
Front sight.	Striker.
Stacking swivel.	Main spring.
Stock.	Extractor.
Upper band.	Safety lock.
Lower band swivel.	Cut-off.
Grasping groove.	Cocking piece.
Hand guard.	Ejector.
Rear sight.	Magazine.
Movable base.	Floor plate.
Windage screw.	Guard.
Windage scale.	Trigger.
Drift slide.	Lower band.
Slide.	Butt swivel.
Slide screw.	Butt plate.
Range scale.	Bayonet.
Bolt.	Bayonet guard.
Bolt handle.	Bayonet grip.
Locking lug.	Bayonet catch.
Sleeve.	Oiler and thong case.
Firing pin.	Brush and thong.

Q. Describe the bullet for ball cartridge.

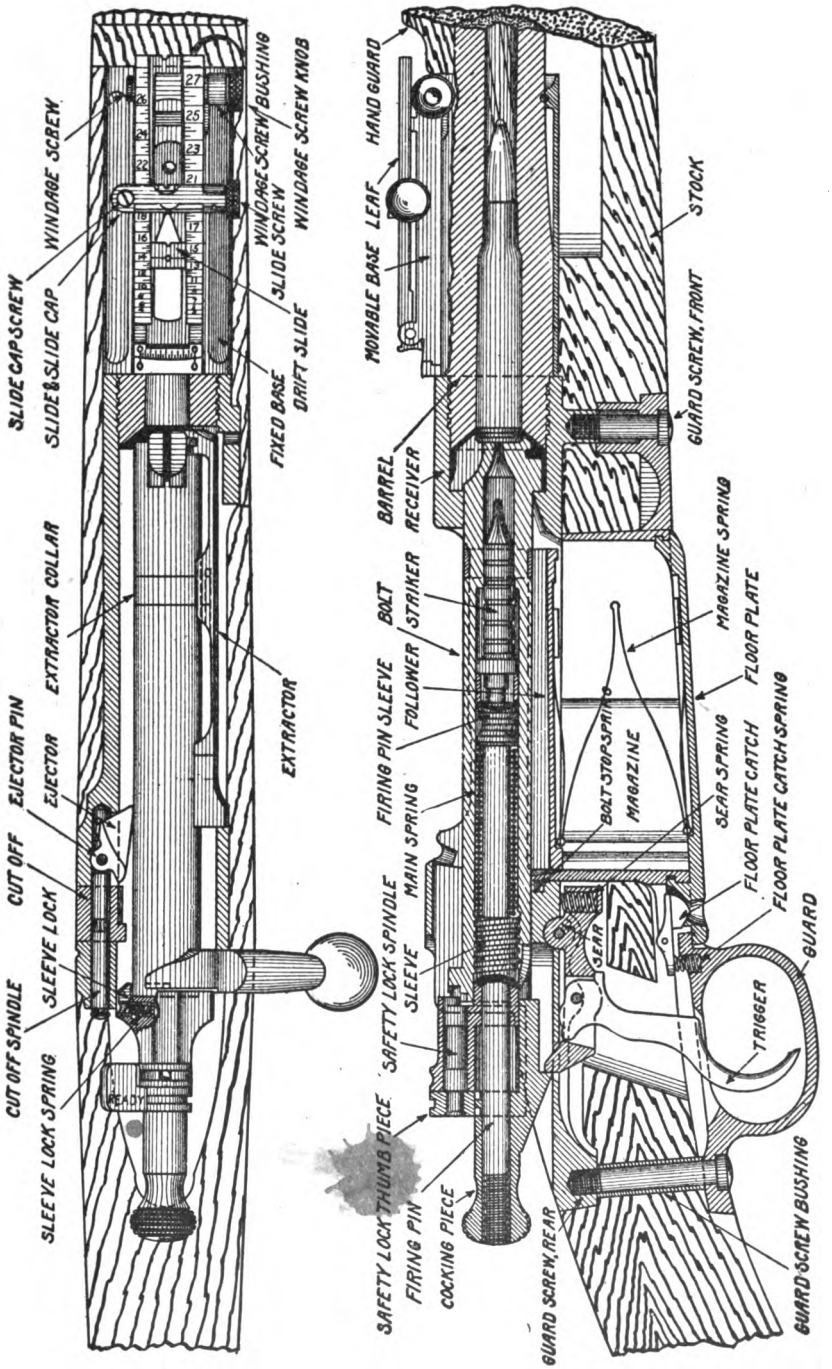
A. It has a core of lead and tin composition inclosed in a jacket of cupro-nickel. The point is very sharp so as to offer little resistance to the air.

Q. Describe the bullet for the old style blank cartridge.

A. The bullet is of paper, hollow, and contains a charge of smokeless powder, which insures the breaking up of the bullet on leaving the bore.

Q. Describe the bullets for the dummy and guard cartridges.

A. The same as the bullet for the ball cartridge. To distinguish it from the ball cartridge, the dummy cartridge has a tinned case provided with six long straight grooves along it and three holes through it. The guard cartridge is distinguished from the ball cartridge by having either 5 grooves



around the case (old style), or six short straight grooves at the shoulder (new style).

Q. What is the shortest range at which dummy ammunition should be used against persons?

A. It is prohibited to fire at persons within 100 yards.

Q. What is the muzzle velocity of the guard cartridge?

A. 1200 f. s.

Q. How should you aim when firing guard cartridges?

A. Use the battle sight and aim at the hips.

Q. What is the muzzle velocity of the ball cartridge?

A. 2700 f. s.

Q. Illustrate to the instructor how you would set the sight for a given range, using both open and peep sights.

Q. Describe the half sight.

A. The top of the front sight is even with the top of the rear sight, and the front sight is in the middle of the rear sight notch.

Q. Describe the peep sight.

A. The top of the front sight is in the center of the peep.

Q. Adjust the sling for firing.

Q. In firing at a vertical target what is the rule for correcting your fire?

A. Square the hundreds in the range. The result is the number of inches on the target that the next shot will strike above (or below) if the rear sight is raised or (lowered) 100 yards.

Q. To apply the rule: If a well aimed shot strikes the width of the bulls-eye below the bull at 300 yards, how much should you raise the rear sight for the next shot?

A. The bulls-eye is 8 inches in diameter. Therefore the shot struck 4+8 inches below the center of the bull. I want to raise the point struck 12 inches. At 300 yards, $3 \times 3 = 9$ inches. Raising my rear sight 100 yards will raise the point struck 9 inches. I would therefore add about 130 yards on my rear sight.

Q. At 200 yards, how much will adding 100 yards on the rear sight raise the point struck by the next shot?

A. $2 \times 2 = 4$ inches.

Q. To shoot to the right (or left), which way would you move the sight?

A. To shoot to the right move the movable base of the sight to the right; to shoot to the left, move the movable base of the sight to the left.

Q. How much does one point on the windage scale correct for?

A. Slightly over 4 inches for every 100 yards of range; so at 300 yards range one point corrects for about 13 inches.

Q. What is the range of battle sight?

A. About 550 yards.

Q. In firing with battle sight, how high is the trajectory above the line of sight at 200 yards?

A. 2¼ feet.

Q. At 300 yards?

A. 2½ feet.

Q. How do you aim in using battle sight at less than 550 yards?

A. Aim at the earth just beneath the target or at the lower edge of the target.

Q. What oils can be used on rifles?

A. For metallic surfaces: sperm oil, cosmic, or other oil approved by the Ordnance Department; when arms are stored, cosmic should be used. For the stock: raw linseed oil; when in the field, the stock should be wiped off occasionally with a cloth moistened with any of the oils enumerated above.

Q. How far does the rifle shoot?

A. About 5400 yards, or a little over 3 miles.

Q. Where are the rifles made?

A. At Springfield Armory, Mass., and at Rock Island Arsenal, Ill.

Q. What is the cost of the rifle?

A. About fifteen dollars.

Q. What is the cost of the service ammunition?

A. About 27 dollars per thousand.

Q. What is the weight of the rifle?

A. About 8¾ pounds.

Q. What is the length of the rifle?

A. About 43 inches.

Q. What does the letter "U" mean on the upper band?

A. If the band is taken off it should be put back with the "U" up, for the band is tapered to fit the barrel and stock.

Q. Through which end of the bore should the cleaning rod be inserted?

A. Always from the breech end; many rifles have been ruined by having the lands worn down at the muzzle by the cleaning rod.

Q. How is the sling cleaned?

A. First wash with a sponge well lathered with castile soap. When partially dry, rub with a lather of harness soap. When nearly dry, rub with a dry cloth to a polish. Dry in a cool place. Never dry leather in the sun.

FIRST CLASS

AZIMUTH INSTRUMENT

Q. What is the name of this instrument?

A. The Warner and Swasey Azimuth Instrument, Model 1900 (or 1910).

Q. Define an angle.

A. An angle is the difference in direction of two straight lines that meet or would meet if sufficiently prolonged.

Q. Draw with chalk, or pencil, an example.

Q. What is a vertical line? Give an example of a vertical line.

A. A line that runs straight up and down; for example, a plumb-bob line.

Q. What is a horizontal line?

A. One that is perpendicular to a vertical line; or, the axis of the spirit level, when bubble is centered.

Q. What is a plane?

A. That which has length and breadth but no thickness.

Q. What is a vertical plane?

A. One containing a vertical line.

Q. What is a horizontal plane?

A. One perpendicular to a vertical line.

Q. Define a horizontal angle.

A. A horizontal angle is one included between two lines lying in the same horizontal plane.

Q. What is a vertical angle?

A. A vertical angle is one included between two lines lying in the same vertical plane.

Q. What kind of angles are measured by the azimuth instrument?

A. Horizontal angles.

Q. How is the instrument graduated to read?

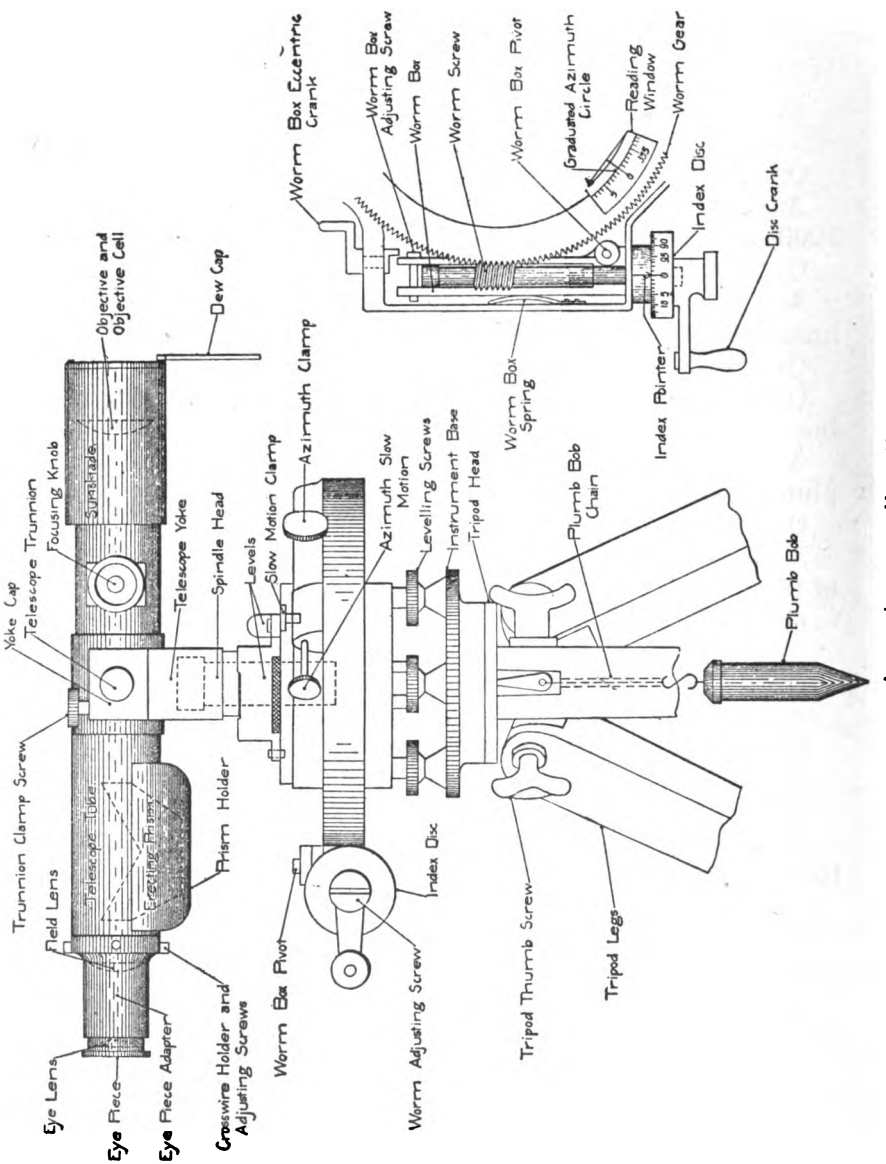
A. In degrees and hundredths of a degree.

Q. Where are the degrees read?

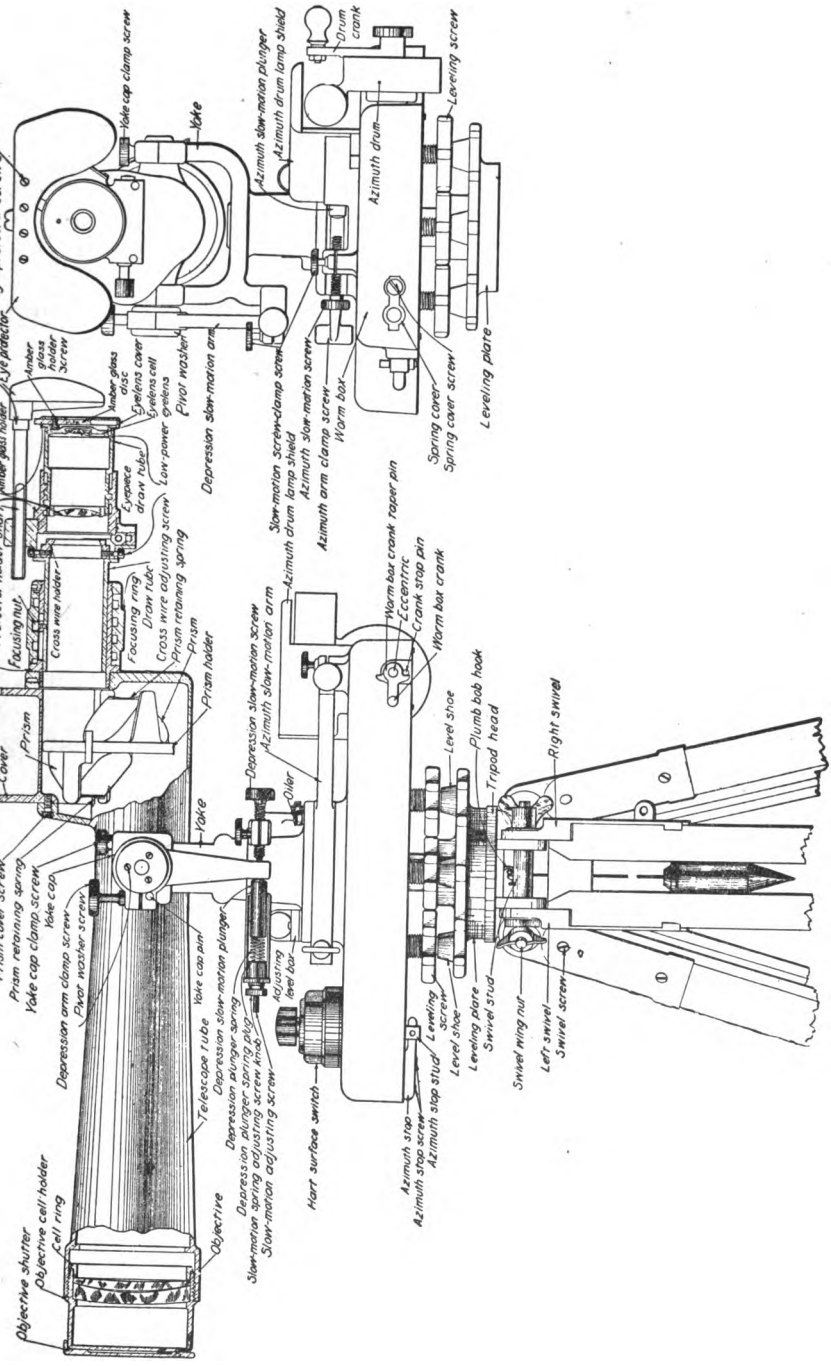
A. On the graduated limb.

Q. What is the value of a space on the limb?

A. One degree.



AZIMUTH INSTRUMENT, MODEL 1900



AZIMUTH INSTRUMENT, MODEL 1910

Q. Where are the hundredths of a degree read?
A. On the graduated index disc.
Q. What is the value of one space on the index disc?
A. One one-hundredth of a degree.
Q. What is meant by orienting the instrument?
A. It means adjusting the instrument so that it will read correct azimuths.
Q. What is an azimuth?
A. It is a horizontal angle measured from the south point (which is zero) of a north and south line, in a clockwise direction, to a line joining the target and instrument.
Q. Describe how to level and orient the azimuth instrument.
A. The instrument is said to be oriented when it is set up so that it will read azimuths. The operation is as follows:
1. Set the graduated circle and index disc to read the azimuth of a known datum point.
2. Make sure the azimuth slow motion screw is about the middle of its play; then, with the azimuth clamp screw loosened, set the eyepiece slightly to the left of the reading window and clamp the azimuth clamp.
3. Raise the whole instrument by grasping the top (*not the telescope*) and turn it so that the telescope points in the general direction of the datum point with the plumb bob over the home station. In orienting the Model 1900 instrument on a pier mount, the instrument may be turned in the proper direction by loosening all of the leveling screws.
(Second and third are not essential to the reading of azimuths, but are provided so that when the adjustment is complete the parts of the instrument will be in the most convenient relative position for operation and reading.)
4. Level the instrument. See that all the screws have a uniform and firm bearing on the leveling plate; turn the worm box eccentric crank so that the worm is released; set one of the levels exactly over two opposite leveling screws, then turn these two screws either both inward or both outward until the bubble comes in the center, being careful to maintain a firm bearing of the screws on the plate. Then perform the same operation with respect to the other two leveling screws. (The bubble moves in the direction of the left thumb in screwing the leveling screws.) Turn the instrument through 180 degrees and if the bubble does not remain in the center, correct one-half of any variation of either bubble by the ad-

justing screws on the level, the other half by the corresponding leveling screws. Repeat this operation until the bubbles remain in the middle of the tubes for any position of the telescope in azimuth.

5. Focus the eyepiece until every roughness on the cross-wires is seen.

Then turn the telescope on some distant object and focus the objective by means of the focussing knob until the vertical wire remains on the same point of the distant object, when the eye is moved to right and left. If the object appears indistinct when the parallax is removed, refocus the eyepiece and objective (changing a little each time) until the object is seen clearly.

6. Bring the vertical wire of the telescope approximately on the datum point; having set on the azimuth circle and index disc the azimuth of this point; tighten the azimuth clamp, and, using the azimuth slow motion screw, bring the vertical wire exactly on the datum point. Clamp the slow motion screw.

Q. How is back-lash eliminated?

A. Adjust the *worm box adjusting screw* so that there is no play between the worm and the worm gear; adjust the *worm adjusting screw* till there is no longitudinal play of the worm in its box. The disc crank should turn freely—neither too tight nor too loose.

Q. Set up, under direction of the instructor, the azimuth instrument over a given point; level, orient, and focus it.

Q. Direct instrument on five successive points (whose azimuths the instructor has previously determined) and read the instrument.

Q. What precautions must be observed in caring for this instrument?

A. Never touch the lenses with the fingers.

Clean the lenses only with soft linen or "optical paper," making sure there is no grit on the linen or paper.

Do not jar the instrument, as a jar may cause the prisms to slip.

Protect the instrument from dust and moisture.

Do not turn the leveling screws as hard as you can.

DUTIES IN THE PLOTTING ROOM

PLOTTING BOARD

General

Q. What is meant by the scale of a plotting board?

A. The ratio between a given distance as measured on the plotting board and the same distance when measured on the earth. For example, the distance between two points on the board is one inch and the distance between the same two points on the water might be 300 yards or 400 yards. Then the scale of the board would be 1 inch equals 300 yards or 1 inch equals 400 yards, as the case might be.

Q. Lay off 1647 yards on the board.

Q. Range and azimuth of a point from a station being given, locate the point.

Q. What zone is this point in?

Q. At what elevation should you fire to reach this point?

Q. What is its azimuth from the directing point?

Q. The azimuth of the target from each of the two stations being given, locate it, and find its range and azimuth from the directing point.

Q. Show how to track a target.

Q. How do you get its travel?

A. By use of prediction scale and set-forward ruler, or by the predictor.

Q. How is time of flight used?

A. The time of flight is used to determine the set-forward point.

Q. How do you get the predicted and set-forward points?

A. By means of the predictor.

NOTE.—All batteries are not supplied with the predictor. For those not yet supplied the answer would be:

A. The predicted point is gotten by the prediction scale and the set-forward point by the set-forward ruler.

Q. What is the predicted point?

A. It is that point on the course of a moving target at which it is predicted that the target will arrive at the end of the predicting interval.

Q. What is it used for?

A. The pieces are fired when the target reaches the predicted point.

Q. What is the set-forward point?

A. It is a point on the course of a moving target in advance of the predicted point at a distance from the predicted point equal to the distance passed over by the target during the time of flight of the projectile for that particular range.

Q. What is it used for?

A. The mortars are laid with an azimuth, elevation, and zone corresponding to the set-forward point.

Q. What data are sent to the pit?

A. The zone, corrected azimuth of the set-forward point, and elevation.

Q. What data are sent to the B.C. station?

A. The azimuth of the predicted point.

Q. Given the azimuth of a point from two base end stations, plot the point.

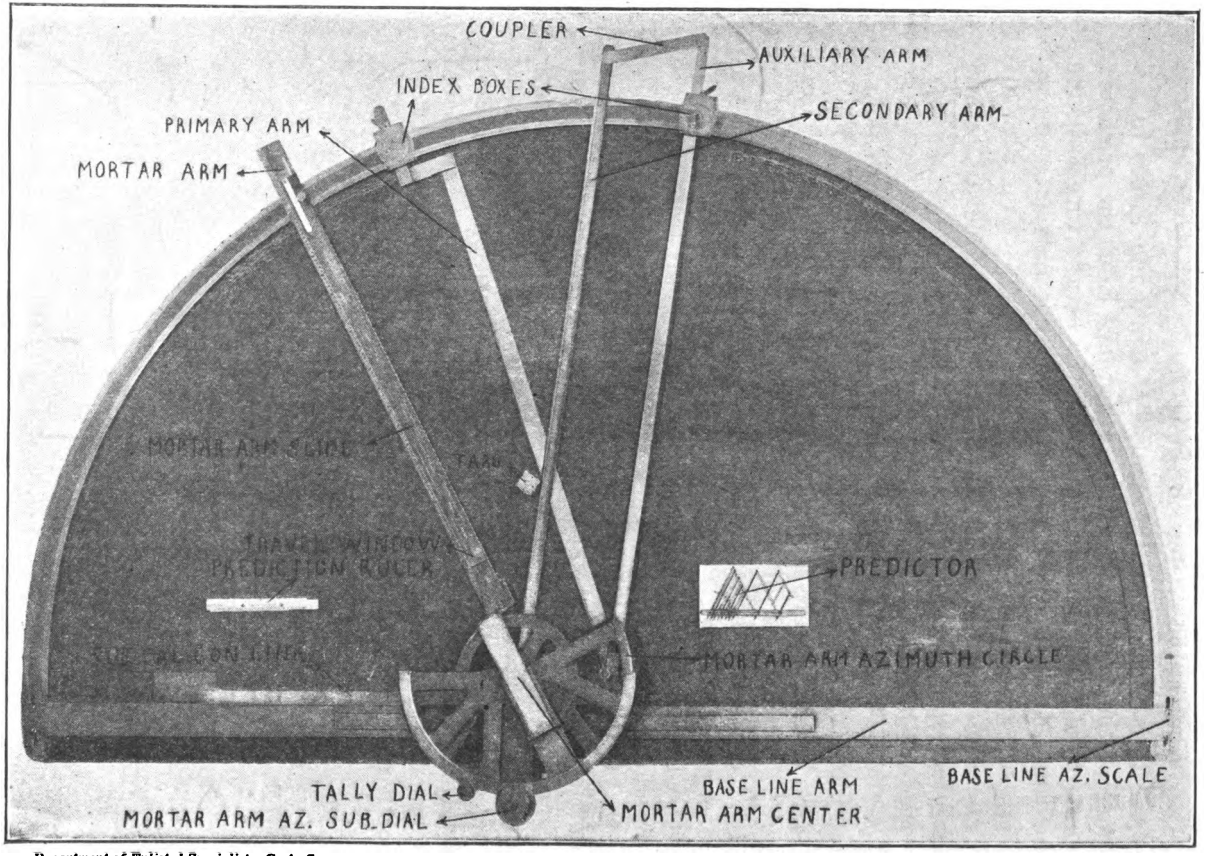
Q. Given the azimuth and range of a point from one base end station, plot the point.

Q. Given two plotted points, determine and mark on the plotting board the predicted point and the set forward point. Using any instruments in the plotting room which are necessary, and given such additional necessary information as range correction, deflection correction from observation of fire, etc.; determine and write down (a) the azimuth of the predicted point; (b) the zone, corrected azimuth of the set-forward point, and the corrected elevation.

Old Style Board (180° Board)

Q. Point out the following:

Primary station.
Primary arm.
Coupler.
Secondary arm.
Secondary station.
Directing point.
Auxiliary arm.
Base line; give length and azimuth.
Mortar arm.
Azimuth circles (primary, secondary, and mortar).
Tally dial.



Department of Enlisted Specialists, C. A. S.

180° PLOTTING BOARD

Index boxes.
Displacement.
Powder zones.
Elevations.
Times of flight.

Q. What is the scale of this board?

A. 1 inch equals 300 yards.

Q. How do you find the distance between two points on the plotting board?

A. Measure the distance with a ruler, remembering 1 inch equals 300 yards.

Q. How are range corrections made?

A. By sliding the elevation scale of the mortar arm in, to increase, and out to decrease, the range.

Q. How do you make correction for drift?

A. By means of the Mortar Deflection Board.

360° Board

Q. Point out the following parts:

Base line arm.
Base line arm subscale.
Clamping lever.
Center pivot.
Center pivot bracket.
Movable arm brackets.
Lateral adjusting slides.
Longitudinal adjusting slides.
Center arm.
Outer arm.
Gun arm.
Gun arm sliding scale.
Auxiliary arms.
Couplers.
Index boxes.
Azimuth circles.
Azimuth correction segment.
Drift slide.
Drift scales.
Drift scale pointer.
Drift Correction slide.
Correction subscale.
Fixed subscale.

Deflection scale.
Targ.
Prediction scale.
Prediction ruler.
Predictor.

Q. What is the scale of the 360° plotting board?

A. Three hundred yards to the inch (boards Nos. 1 and 2, first constructed, are 400 yards to the inch).

Q. What is the value of each graduation on the gun arm? On the baseline arm? On the vernier of the movable arm bracket?

A. Ten yards. Twenty-five yards. One yard.

Q. What is the center station?

A. The base end station whose arm is pivoted at the center of the plotting board. It is usually the station farthest from the battery, but if the nearest station is far enough from the battery for satisfactory coupling it may be used as the center station.

Q. What is the outer station?

A. The base end station whose arm is not pivoted at the center of the board.

Q. What is a right-hand base line?

A. One whose outer station is on the right of the center station for a person looking toward the field of fire. In this case the graduated edges of all arms are on the right. For a left-hand station the outer station is on the left and the left edges of arms are graduated.

Q. Set the movable arm bracket for a right-hand base line_____yards long.

Q. What is the longitudinal adjusting slide?

A. The longitudinal adjusting slide is a bronze slide with a scale in yards, to which the mortar arm is attached, and by means of which the directing point of the battery is placed in a position on the board corresponding to the distance of the directing point of the battery in front or rear of the base line.

Q. What is the lateral adjusting slide?

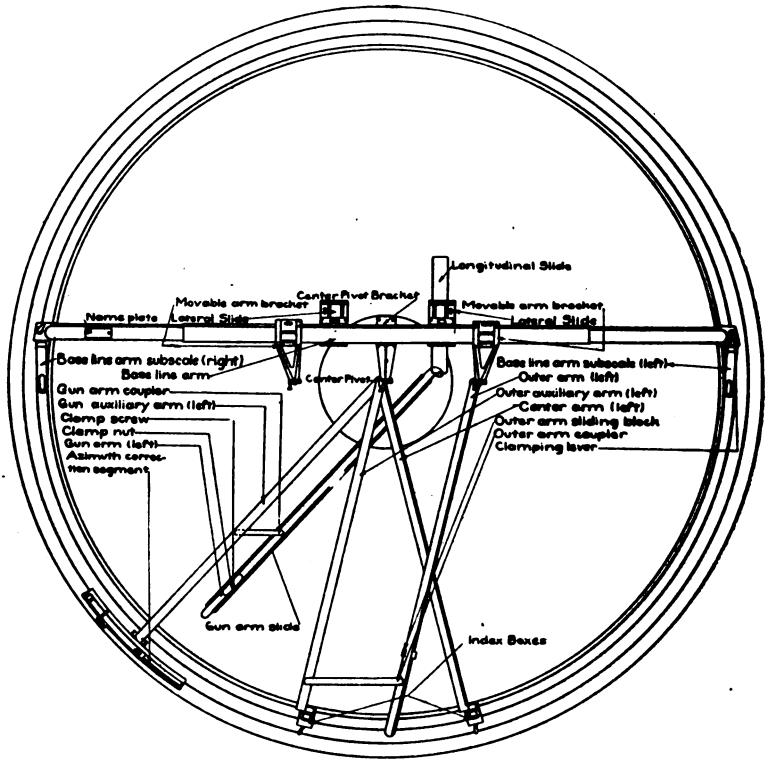
A. The lateral adjusting slide is a bronze slide holding the longitudinal adjusting slide moving along the tongue, parallel to the base line, by means of which the directing point of the battery is moved to a position corresponding to the distance of the battery to the right or left of the center station.

Q. The directing point of the battery is ------ yards to the right and ------ yards to the rear of the center station.

Set the lateral and longitudinal slides.

Q. How is the board changed from a right-hand to a left-hand base line of different azimuth and length?

A. Remove all couplers, lift arms from index boxes, remove the center arm and auxiliaries from the board. Un-



360° MORTAR PLOTTING BOARD MODEL 1911

clamp the base line arm by the clamping lever. Rotate base line arm to the correct azimuth, as determined by the subscale and clamp. Swing the outer and gun arm around near the base line arm out of the way and fasten the left-hand center arm and auxiliaries in the center pivot bracket. Set the movable arm bracket (left) to the length of the new base line and insert the outer arm. Place the gun arm on the board and adjust the lateral and longitudinal adjusting slides to the proper distances.

Place the center arm and outer arm auxiliary in the index boxes and assemble the proper couplers.

Q. What scales are used in reading the azimuth of the predicted point?

A. The mortar azimuth circle scale and the subscale for the predicted point.

Q. What scales are used to locate the set-forward point?

A. The prediction scale and the set-forward ruler, under the present system. The set-forward point can also be found by use of the predictor, without the use of the prediction scale and set-forward ruler.

Q. How is the corrected azimuth of the set-forward point obtained?

A. The azimuth correction segment is used for this purpose. The index line on the drift scale is set opposite the required number on the deflection scale. The drift scale pointer is then set to the elevation called off by the operator of the mortar range board, and the azimuth is read from the mortar azimuth circle and the correction subscale. This corrects the azimuth for drift.

Q. What is the purpose of the deflection scale?

A. To lay off arbitrary deflection corrections.

Q. What is an arbitrary deflection correction?

A. The deviation from the normal drift of a projectile is the deflection to be corrected for. This correction is made for each shot and is arbitrary: it is *not* a percentage factor.

Q. What is the purpose of the drift percentage scale?

A. The deflection of a projectile may be increased or decreased by the wind or other causes. The variation in deflection from the normal drift is approximately a percentage of the drift. That is, if it is found that for 50 degrees elevation the deflection is 20% more than the range table drift, it will also be 20% greater than the range table drift for any other elevation. −20 means that you are making a 20% correction to the left because the projectile fell 20% of the drift too far to the right. The numbers on the drift scale do not refer to zones. Note that the diagonal lines run up to the right for + and up to the left for −.

Q. How are percentage drift corrections made?

A. The proper drift scale is assembled in the drift scale slide. The drift scale pointer is set to the proper graduation on the drift percentage scale. It is then brought to the line for the given elevation.

Q. What special care of the plotting board is required?

A. The bearings provided with oil holes and the arm pivots and the coupler pivots should be oiled with a few drops of oil once a month. The sliding surfaces of lateral and longitudinal slides and the azimuth correction segments, require no oil. No oil should be used on clamping surfaces. All bearing surfaces and graduated scales should be kept clean. *No* parts of the board should be polished. Surfaces which are lacquered may be cleaned by a damp cloth and castile soap.

110° PLOTTING BOARD

Q. Point out the following parts:

Auxiliary azimuth circles.	Gun arm pivot.
Azimuth circles.	Gun center bracket.
Center station plug.	Gun center pivot.
Center station plug bushing.	Index boxes.
Couplers.	Index box subscales.
Gun arm.	Station plate.
Gun arm index.	Station arms.
Gun arm subscale.	Station sleeves.

Q. What is the scale of the 110 degree board?

A. 400 yards to the inch.

Q. What is the value of the smallest reading on the gun arm? On the station arms? On the azimuth circle? On the auxiliary azimuth circles? On the index box subscales? On the gun arm index subscale?

A. 10 yds. 10 yds. One degree. One degree. 0.05 of one degree. 0.05 of one degree.

Q. Set the station arms for a given base line. Set them again for the same base line, but use station sleeves in another quadrant. In each case, show what azimuth circle is used.

Q. When using this plotting board, how is the azimuth corrected for drift?

A. The actual azimuth read from this board is corrected on the Mortar Deflection Board.

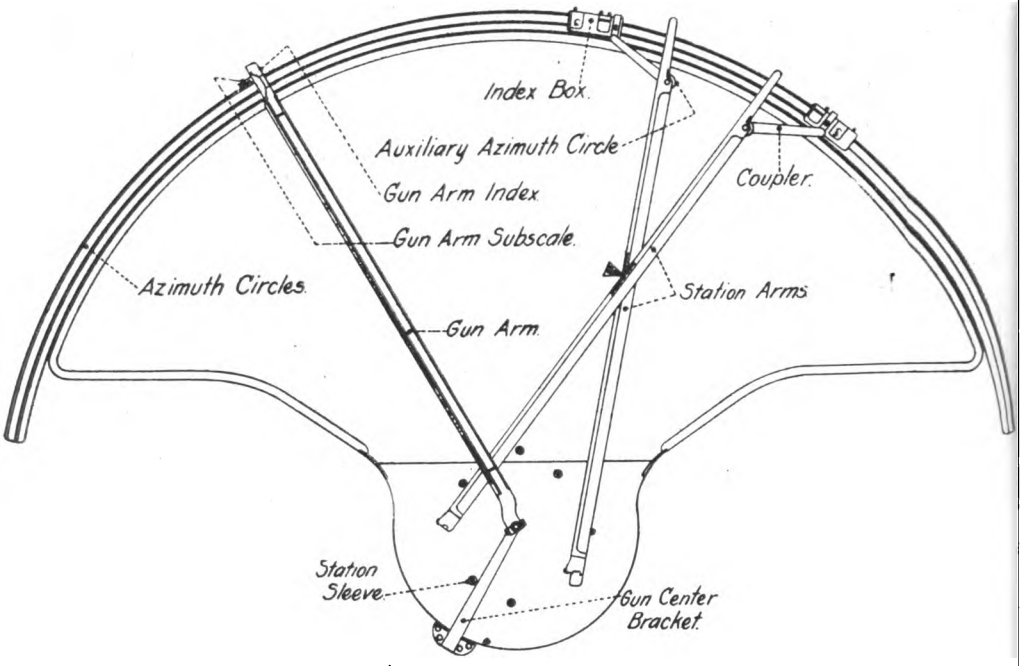
Q. How is the range corrected?

A. The actual range read from this board is corrected on the Elevation Board.

Q. When and how are the extra index box subscales, marked respectively -3 and -3, used?

A. Used when the regular subscale is obscured by a coupler or other obstruction. When these subscales are used, three

(3) degrees are added to or subtracted from the azimuth reading obtained from them, depending on which is used.



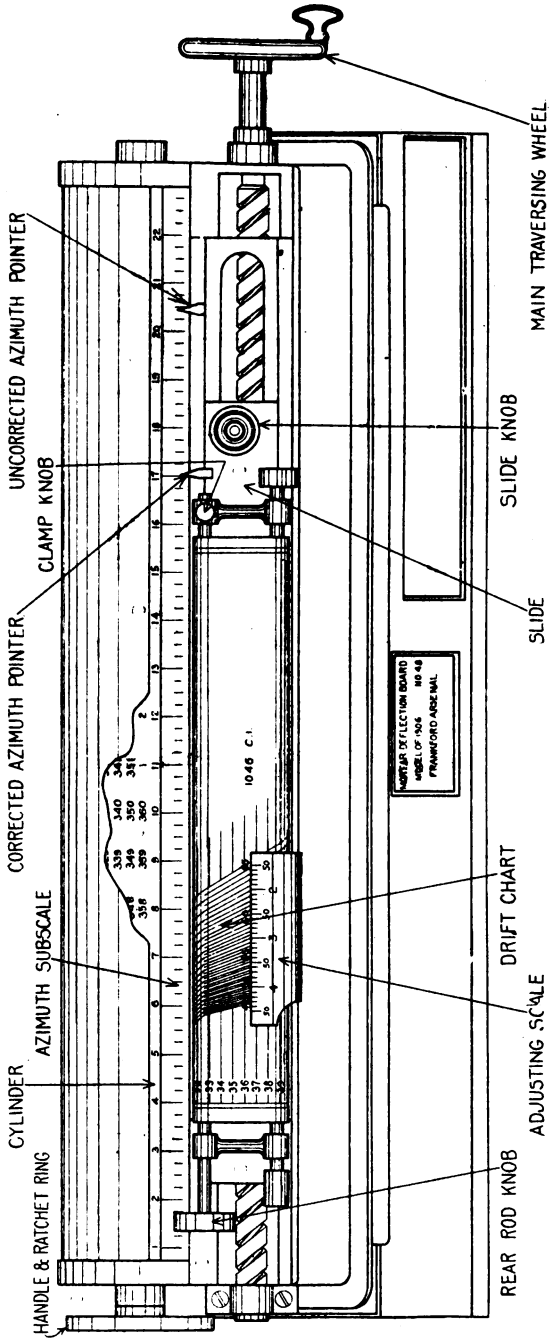
110° PLOTTING BOARD

MORTAR DEFLECTION BOARD

With De Carre Drift Chart

Q. Explain how to operate this board.

A. Turn the handle and ratchet ring until the proper degree on the cylinder is brought into view. Set the uncorrected azimuth pointer marked "Set" to the uncorrected azimuth of the set-forward point by turning the main traversing wheel. Set the drift chart to the normal for the projectile being used, by rotating the rear rod knob; then clamp the rear roller by tightening up on the clamp knob. (The correct position is indicated when the upper edge of the adjusting scale coincides with the horizontal line of the drift chart on which the type of projectile to be used is marked.) Set the *normal* (3.00) or index pointer of the adjusting scale to the elevation determined from the range elevation board; this is done by turning the slide knob. Read the corrected azimuth under the corrected-azimuth pointer marked "Read."



MORTAR DEFLECTION BOARD WITH DE CARRE DRIFT CHART

In case it is desired to make deflection corrections from observation of fire, proceed as follows: First, note from an azimuth instrument located at the battery the point of fall of the splash, that is, the reading of the splash, taken with reference to the target on the lateral deviation scale of the azimuth instrument. Assume the splash to fall on this scale at 2.75 or 0.25 degrees right. Note the elevation at which this shot was fired. Loosen the clamp knob, then by means of the rear rod knob, turn the drift chart until the elevation line, for the elevation at which the shot was fired, coincides with the reading 2.75 on the adjusting scale; then again tighten the clamp knob. Thereafter, proceed exactly as described in the preceding paragraph.

MORTAR RANGE BOARD

Q. Point out the following parts:
Range scale.
Zone scales.
Range slide.
Range scale correction scale.
Range and correction scale index.
Elevation index.
Elevation index slide.
Zone correction scale.
Zone to zone correction scale.
Time of flight scale.

Q. How is the time of flight obtained?

A. From the time of flight scale on the mortar range board. The time of flight for the set-forward point may be obtained by the plotter making an estimate of the range of the set-forward point, after which the time of flight is obtained from the mortar range board.

Q. How is the elevation obtained?

A. By moving the range slide until the index is opposite the given range and reading the elevation at the elevation index.

Q. How are range corrections made?

A. *1st.* By moving the gun arm slide on the plotting board in, to increase, and out, to decrease the range, the amount of correction being set on the gun arm sliding scale. *2nd.* By means of the range slide on the mortar range board.

Q. How are range corrections applied to the mortar range board?

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range scale

is desired to

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range board?
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THE PREDICTION SCALE

Q. Describe and explain the use of the prediction scale.

A. It is a device used to measure the travel of the target during a given interval and to locate the predicted point. Under the present system it is used to measure the yards traveled per minute, to locate the predicted point, and, after the distance to the set-forward point has been obtained from the set-forward ruler, to locate the set-forward point. The value of each graduation on the prediction scale is 10 yards. The predictor is a mechanical device used to locate the predicted point and set-forward point without the use of either the prediction scale or set-forward ruler. This is not used as a part of the present system.

ALTERNATE PLOTTING STATION ORGANIZATION AND EQUIPMENT

(This section covers organization and equipment along the general lines described in the JOURNAL OF THE UNITED STATES ARTILLERY for June, 1920, pages 584-604 inclusive.)

Manning Party

Q. Name the members of the plotting room manning party.

A. Plotter, who plots the course of the target on plotting board and has general charge of the work in plotting room.

No. 1. Assistant plotter, who assists the plotter and operates wind component indicator.

No. 2. Primary arm setter, and

No. 3. Secondary arm setter, who set off azimuth sent from observing stations using primary and secondary arms.

No. 4. Range Prediction Board Operator, who determines on the range prediction board, the range to the set forward point, applies arbitrary range corrections given by the range officer and also applies ballistic range corrections as determined by the Pratt Range Correction Board Operator.

No. 5. Assistant Range Prediction Board Operator, who assists No. 4.

No. 6. Direction Prediction Board Operator, who determines on the prediction board, the azimuth to the set forward point, who applies arbitrary deflection corrections given by the range officer and also applies ballistic deflection corrections as determined by the Direction Correction Board Operator.

No. 7. Assistant Direction Prediction Board Operator, who assists No. 6.

No. 8. Range Correction Board Operator, who determines on the Pratt Range Board range corrections due to velocity, atmosphere, tide and wind.

No. 9. Direction Correction Board Operator, who determines the corrections in direction due to wind and drift.

No. 10. Who operates the mortar range board.

Operation of plotting board

The primary and secondary arm setters set the primary and secondary arms to the azimuths received from the observing stations.

The plotter marks, using the targ, the intersection of these arms and as soon as the arms are cleared, places the mortar arm so as to read the range from the directing point to this plotted point. The assistant plotter reads the azimuth of this point.

Meteorological message and wind component indicator

Q. What is the meteorological message or as it is sometimes called, the daily message?

A. It is a message from the Meteorological Station. It contains information for correcting the elevation and deflection to be used at the guns before firing.

Q. How often is the daily message received?

A. At least every half hour.

Q. What information does it contain?

A. 1. Height of tide.

2. The ballistic wind. This is the wind velocity, in miles per hour (or meters per second), and the azimuth in degrees from which the wind is blowing. These data are obtained by observing and plotting the course of a small free balloon from the time it leaves the ground until it reaches the highest point of the trajectory for the range at which the gun is to be fired. The wind velocity and azimuth are not for any one level but show the effect upon the projectile during its entire flight.

3. Atmosphere reference number. Usually the thermometer and barometer readings from which the atmosphere reference number was determined, are also sent.

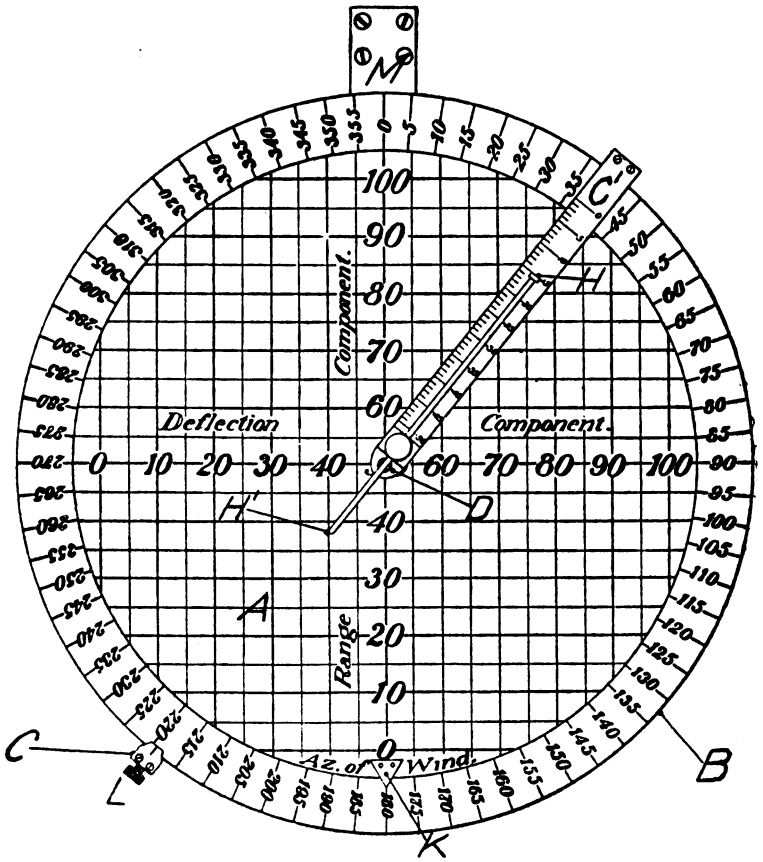
Q. What use is made of the wind azimuth and velocity?

A. They are used on the wind component indicator.

Q. Tell how to use the wind component indicator.

A. (See illustration of Wind Component Indicator). Set the pointer (H) to the wind velocity, and by turning the

movable azimuth ring (B) bring the wind azimuth to the pointer (K). Set the target arm (C′) to the azimuth of the target, as indicated by the gun arm of the plotting board, using the index (C).



WIND COMPONENT INDICATOR

The reference numbers to be used on the range correction and direction correction boards are indicated by the end (H′) of the pointer.

Always read the figures which run up and down for range correction board wind reference number, and the figures which run right and left for direction correction board wind reference number.

Range Correction Board

Q. What information is necessary to operate the range correction board, and where is it obtained?

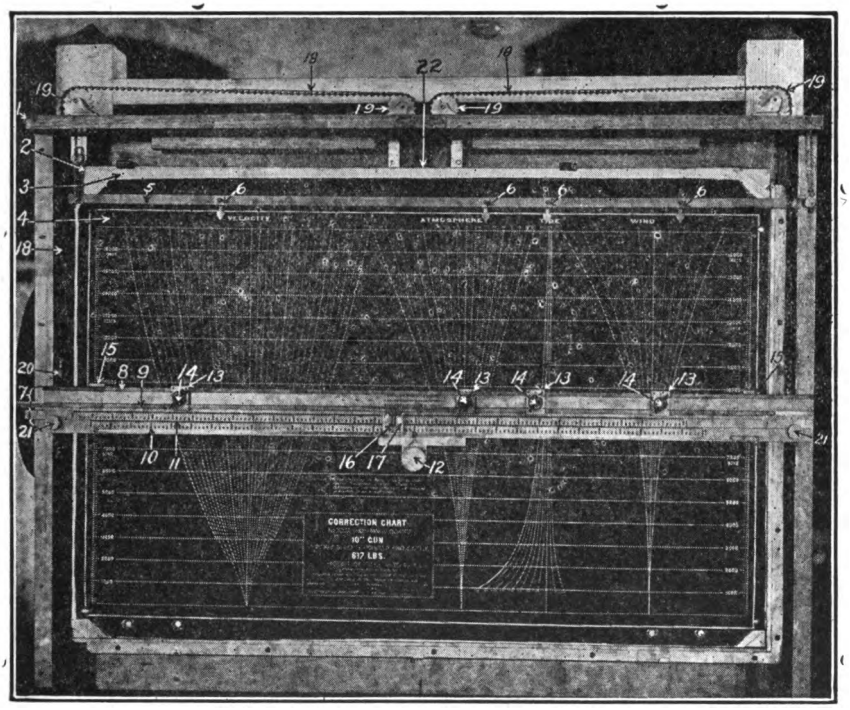
A. 1. Height of tide: from daily message or direct from F. C. Station.

2. Atmosphere reference number: from daily message.

3. Muzzle velocity: from battery commander.

4. Wind reference number: from wind component indicator.

5. Range to set forward point: from gun arm of plotting board.



RANGE BOARD, MODEL 1905

1. BOX (MAHOGANY).
2. CHART FRAME.
3. CANVAS CHART MOUNT.
4. CORRECTION CHART.
5. BAR FOR MARKERS.
6. MARKERS (CURVE INDICATORS).
7. CORRECTION RULER.
8. FIXED BAR.
9. MOVABLE BAR.
10. FIXED RANGE SCALE.
11. MOVABLE RANGE SCALE.
12. KNOB.
13. POINTERS.
14. CLAMP.
15. FIXED INDEXES.
16. MOVABLE INDEX.
17. READING GLASS.
18. CHAIN.
19. CHAIN SPROCKET.
20. CHAIN ADJUSTING SCREW.
21. CLAMPING SCREW.
22. COUNTERWEIGHT (CONCEALED BY CHART FRAME).

Q. How do you keep track of this information on the range correction board?

A. By sliding the markers at the top of the board so that they point to the numbers of tne curves to be used.

Q. Explain the complete operation of the range board.

A. 1. Set each marker (6) at its proper correction curve.

2. Set each pointer (13) at normal (red line).

3. Make the fixed (10) and movable (11) range scales coincide.

4. Set the movable index (16) at the actual range of the setforward point, on the fixed range scale.

5. Set the ruler (7) at the actual range of the setforward point.

6. Make the correction for atmosphere as follows:

a. Turn the clamp (14) to M;

b. Turn the knob (12) until the pointer indicates the proper correction curve;

c. Turn the clamp (14) to S.

7. Make the correction for velocity in a manner similar to that indicated in 6 above for atmosphere.

8. Make the correction for tide in a manner similar to that indicated in 6 above for atmosphere.

9. Make the correction for wind in a manner similar to that indicated in 6 for atmosphere.

10. Read on the movable scale, the value that appears opposite the 11,000 on the fixed scale.

11. This value or reference number is set off on the range Prediction Board.

Direction Correction Board

Q. What information is necessary to operate the direction correction board, and where is it obtained?

A. 1. Wind reference number: From wind component indicator.

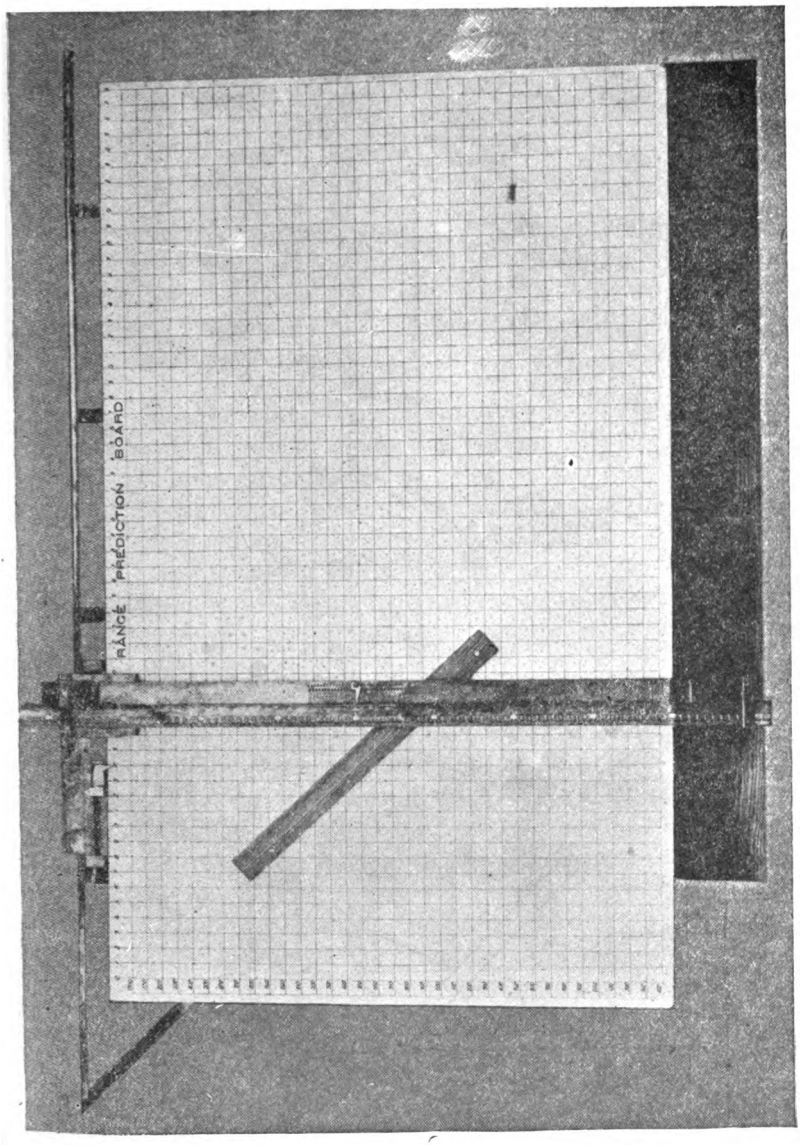
2. The factor determining drift, which is the range: From the range obtained by the reading of mortar arm by plotter.

Q. How do you keep track of this information on the direction correction board?

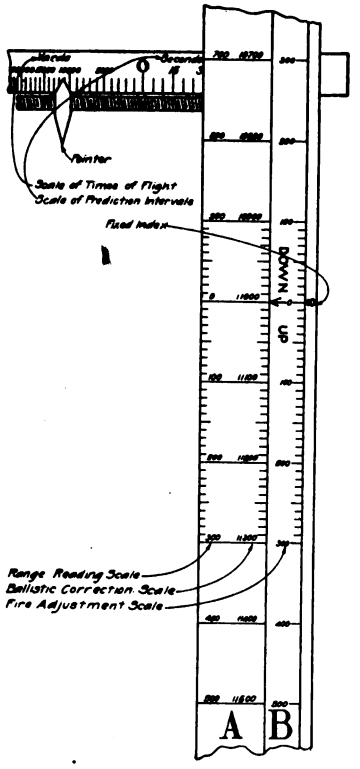
A. This board is similar in design and construction to the Pratt Range Board and is operated in the same manner. The only difference being that the corrections are for lateral deviations. The curves are for wind and drift.

Q. What readings are obtained from this board and how are they used?

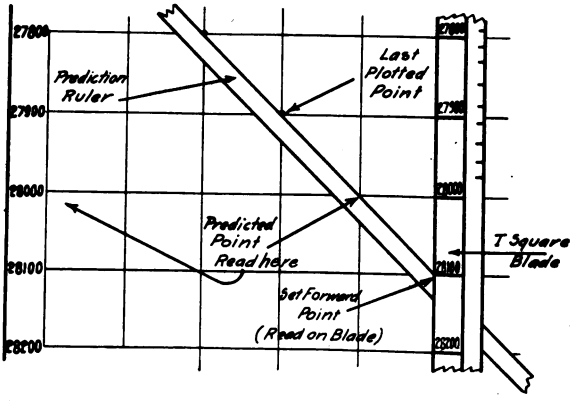
A. The value on the fixed scale opposite 11,000 on the movable scale is read and is set off on the direction prediction board as a reference number.



RANGE PREDICTION BOARD



DETAIL OF T-SQUARE, RANGE PREDICTION BOARD



METHOD OF PLOTTING, RANGE PREDICTION BOARD

Range Prediction Board

Q. What information is necessary to operate the range prediction board?

A. 1. The true range to the plotted points, given by the plotter.

2. The range corrections, given by operator Pratt Range Board.

Point out the following:

Scale for prediction interval.
Time of flight scale.
Pointer.
Range reading scale.
Ballistic correction scale.
Fire adjustment scale.
Prediction Ruler.
"T" square blade.
Fixed Index.

Q. What is the value in time of one of the squares on the cross section paper, measured horizontally?

A. Thirty seconds.

Q. What is the value in range of one of the squares on the cross section paper, measured vertically?

A. One hundred yards.

Q. Where are arbitrary corrections received from the range officer made?

A. On the fire adjustment scale.

Q. Where are corrections received from the range correction board made?

A. On the Ballistic Correction Scale.

Q. What is the normal on the ballistic correction scale?

A. 11,000.

Q. What is the normal of the fire adjustment scale?

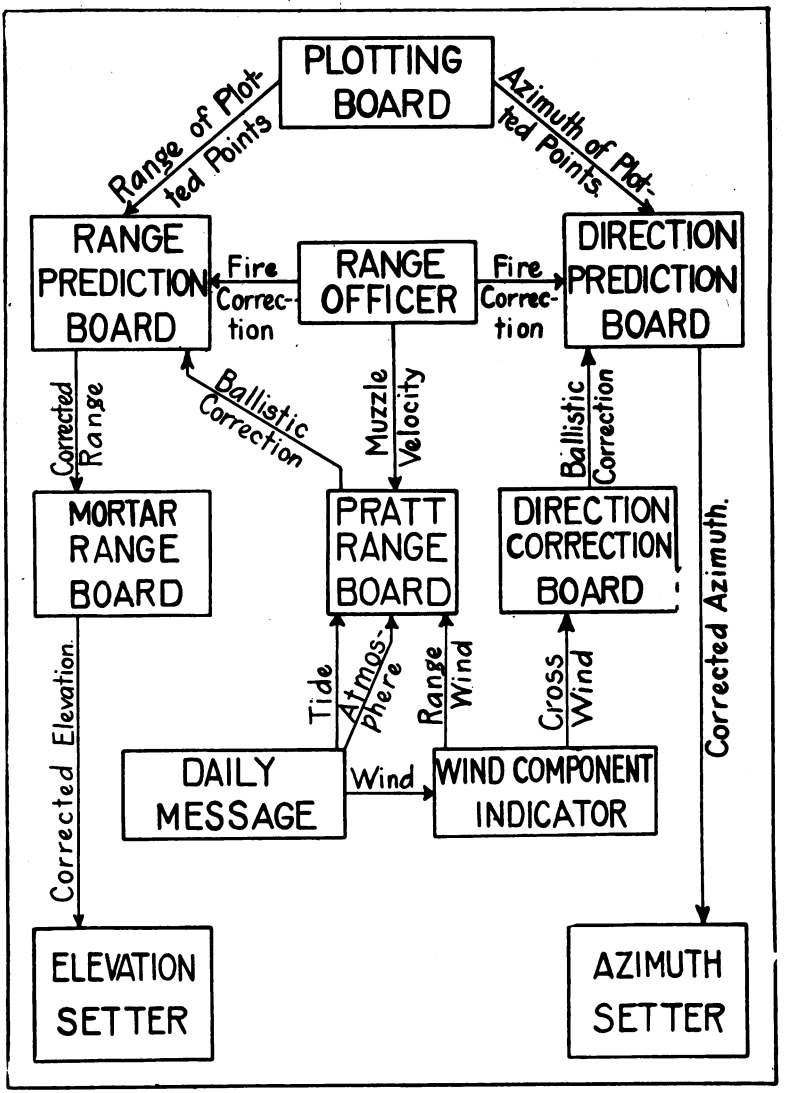
A. Zero.

Q. Explain the operation of the range prediction board.

A. (a) The plotted point is indicated by a dot on the cross section paper, on the proper time line, and on the proper range line. The range in hundreds of yards only, is shown in the column on the left hand margin, so the thousands are filled in with pencil.

(b) The position of the second plotted point is shown in the same manner and is to the right on the next time line and either up or down depending on whether the range for the second plotted point is less or greater than the first.

(c) The time of flight scale is adjusted so as to read the range of the last plotted point.



(d) The pointer is placed directly above the last plotted point.

(e) The prediction ruler is so placed that the edge touches both plotted points and the ruler passes under the T square. The corrected range to the set-forward point is read on the T square at the point where the range prediction ruler intersects the T square.

(f) The ballistic corrections (from the Pratt Range Board) and the fire adjustment corrections (from the range officer) are made on the proper scales.

Direction Prediction Board

Q. What information is necessary to operate the direction prediction board?

A. (1) The azimuth of the plotted points, given by the plotter.

(2) The correction obtained from the operator, direction correction board.

This board is similar in design and construction to the range prediction board and is operated in exactly the same manner.

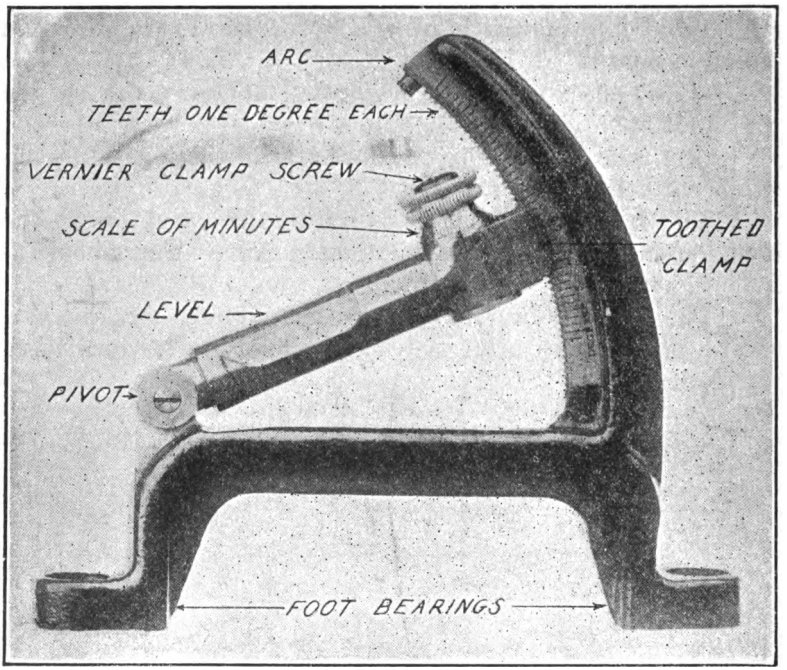
The result obtained being the azimuth of the set-forward point, after arbitrary and ballistic corrections have been made.

(c) LAYING MORTARS

Q. Set the quadrant according to data given you by the instructor.

Q. The instructor will set the quadrant. Read it.

Q. Where do you place the quadrant when using it with mortars?



Department of Enlisted Specialists, C. A. S.
ELEVATION QUADRANT, MODEL 1906

A. On the quadrant seat provided on the line of metal at the breech.

Note.—The quadrants are now being attached permanently to the rimbase, in the newly modified carriages.

Q. How is the quadrant placed?

A. With the feet sitting squarely on the place provided and in a vertical plane containing the axis of the bore.

Q. With data received from the plotting room lay the piece.

Q. What is Case III?

A. Elevation by quadrant, direction by azimuth circle.

(d) TIME–AZIMUTH BOARD

Q. Explain the use of the time-azimuth board which is used in your battery.

(e) DEFINITIONS, D. R. C. A., 1914*

Q. What is the trajectory?

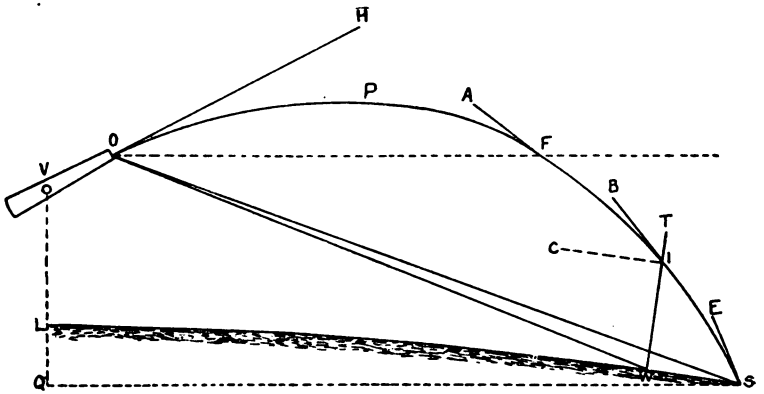
A. The curve described by the center of gravity of the projectile. (Draw and label it.)

Q. What is the axis of the bore?

A. The center line of the bore. (Draw and label it.)

Q. What is the line of departure?

A. The prolongation of the axis of the bore at the instant the projectile leaves the bore. (Draw and label it.)



OPS	Trajectory.	QS	Range of shot.
F	Point of fall.	TW	Target.
I	Point of impact.	ESQ	Angle of splash,—danger angle.
S	Point of splash.	HOF	Quadrant angle of departure.
W	Center of target.	AFO	Angle of fall (Range Table) for horizontal range OF.
LV	Height of site.		
OH	Line of departure.		

Q. What is the line of sight?

A. A straight line passing through the sights of the piece and the target. (Draw and label it.)

Q. What is drift?

A. It is the divergence from the plane of departure of the projectile under the influence of the rotation of the projectile and the resistance of the air. In our service it is always to the right. (Draw and label it.)

Q. What is muzzle velocity?

* See Appendix "B".

A. It is the velocity of the projectile as it leaves the muzzle, measured in feet per second.

Q. What is jump?

A. It is the increase or decrease of the elevation at the instant the projectile leaves the gun. (Draw and label it.)

Q. What is quadrant elevation?

A. The angle between the horizontal and the axis of the bore when the piece is pointed. (Draw and label it.)

Q. What is the quadrant angle of departure?

A. The angle between the horizontal and the axis of the bore at the instant of firing. (Draw and label it.)

Q. What is sight elevation?

A. The angle between the line of sight and the axis of the bore. (Draw and label it.)

Q. What is the danger angle, or angle of splash?

A. It is the angle that the tangent to the trajectory at the point of splash makes with the plane containing the point of splash and parallel to the horizontal plane through the muzzle of the piece in the firing position. (Draw and label it.)

Q. How is the angle of fall expressed?

A. Either in degrees and minutes, as 5° 16′, or as 1 on 17.

Q. What does 1 on 17 mean?

A. That the projectile falls vertically 1 yard in going 17 yards on the horizontal.

Q. What is time of flight?

A. The time required for the projectile to travel from the gun to the point of impact.

In addition to the questions and answers listed above, every first class gunner should be acquainted with the meaning of the terms listed below. They are defined in Appendix D. Instructors and examining officers should remember that nothing is gained, and much time is wasted, by compelling the soldier to learn these definitions in a parrot-like manner: all that should be required is that he be able to explain, *in his own words*, the general meaning of the term in a satisfactory manner.

Axis of the gun
Base point
Base line
Y-azimuth
Bore
Bore-sighting
Caliber
Crusher guage
Degree
Erosion
Field of fire
Fire, kinds of
In battery—From battery
Gun or piece

Cartridge case	A load
Clinometer	Lot, powder
Clinometer rest	Map range
Communications	Pressure cylinder
Mark one, (two, three, etc.)	Rated Men
Mil	Recoil and counter-recoil
Meteorological Station	Referring point
Point of burst	Registration point
Point of impact	Rifle and smooth bore
Pointing	Ricochet
Position finder	Round
Position finding instrument	Salvo
Primary armament	Salvo interval
Secondary armament	Sight
Parapet,parados,andtraverse	Sub-caliber tube
Pyramidal target	Tide station
Range	Twist of rifling
Range finder	Zone
Range table	Relocation

In order that the soldier may understand the object of fire adjustment, and realize that even with perfect adjustment the shot may not strike the target, it is desirable that he should understand, *in a very general way*, the following terms:

Dispersion	50% zone
Dispersion ladder	
Calibration	Pattern
Center of impact	Danger space

(f) GENERAL FEATURES OF WARSHIPS

Q. How may warships be classified?

A. The general broad classification which is at present accepted throughout the world is:

(1) Armored ships, including:
  (a) Dreadnoughts (16,000 tons and over).
  (b) Battle-cruisers (dreadnoughts) (17,000 tons and over).
  (c) Battleships (pre-dreadnoughts) (11,000 to 16,000 tons).
  (d) Armored cruisers (9000 to 15,000 tons).
  (e) Monitors (3000 to 8000 tons).

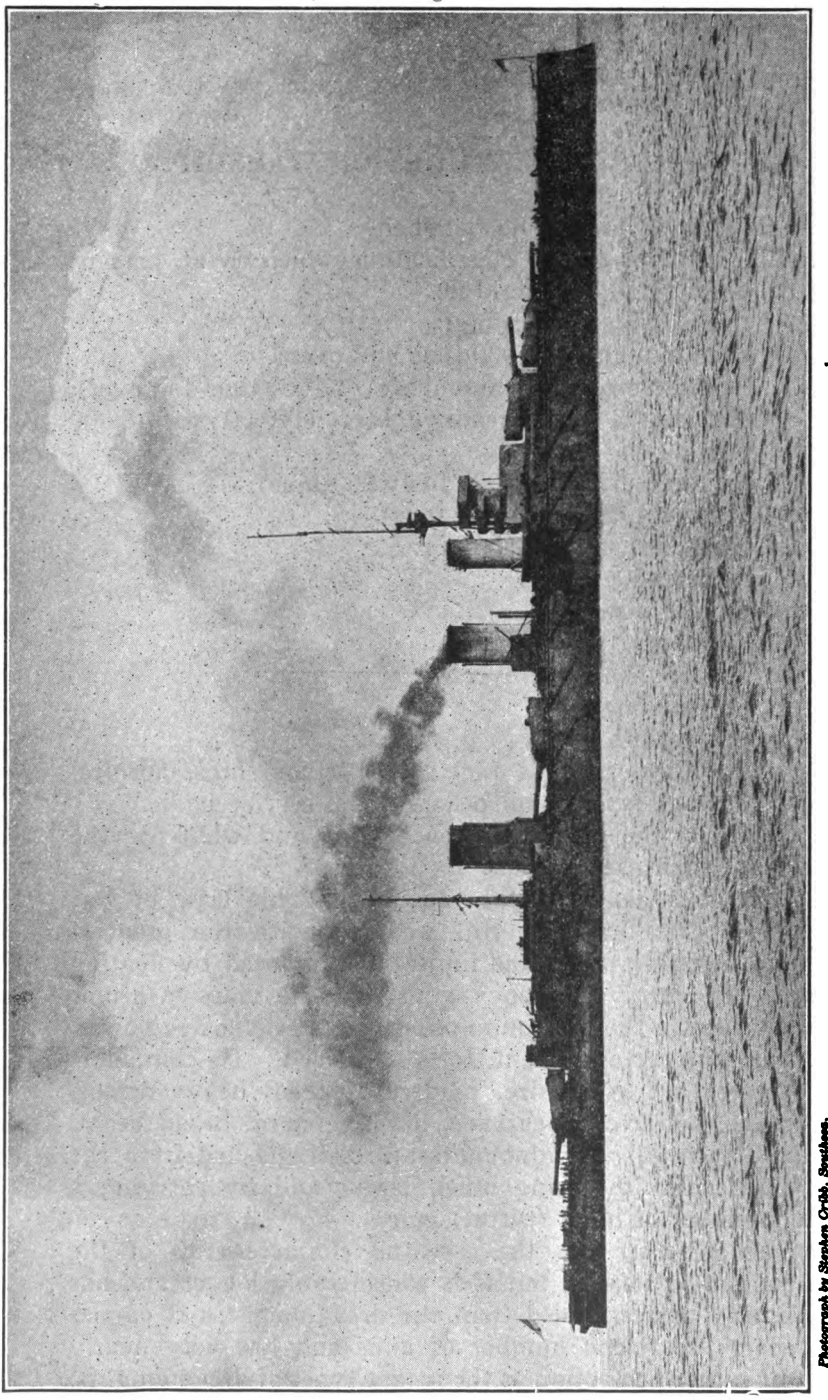
(2) Unarmored ships, including:
  (a) Protected cruisers.
  (b) Scout cruisers.
  (c) Gunboats.
  (d) Torpedoboat destroyers
  (e) Torpedoboats.
  (f) Submarines.

(3) Auxiliaries, such as fuel ships, repair ships, hospital ships, tugs, mine layers, and other special service boats.

Q. What is the purpose of each class and what are the characteristic features of each?

A. The *dreadnought* is the most formidable type of war vessel, and combines powerful weapons with the greatest protection possible under the limitations imposed by floating warfare. To carry the heavy guns and the massive armor necessary to give the maximum offensive and defensive power, speed has, to a certain extent, to be sacrificed. Its characteristic features are great size, moderate speed, heavy armor, heavy guns, massive appearance, low freeboard, broad beam, and large turrets. Dreadnoughts are distinguished from the older battleships by being much larger and by carrying a greater number of large (turret) guns.

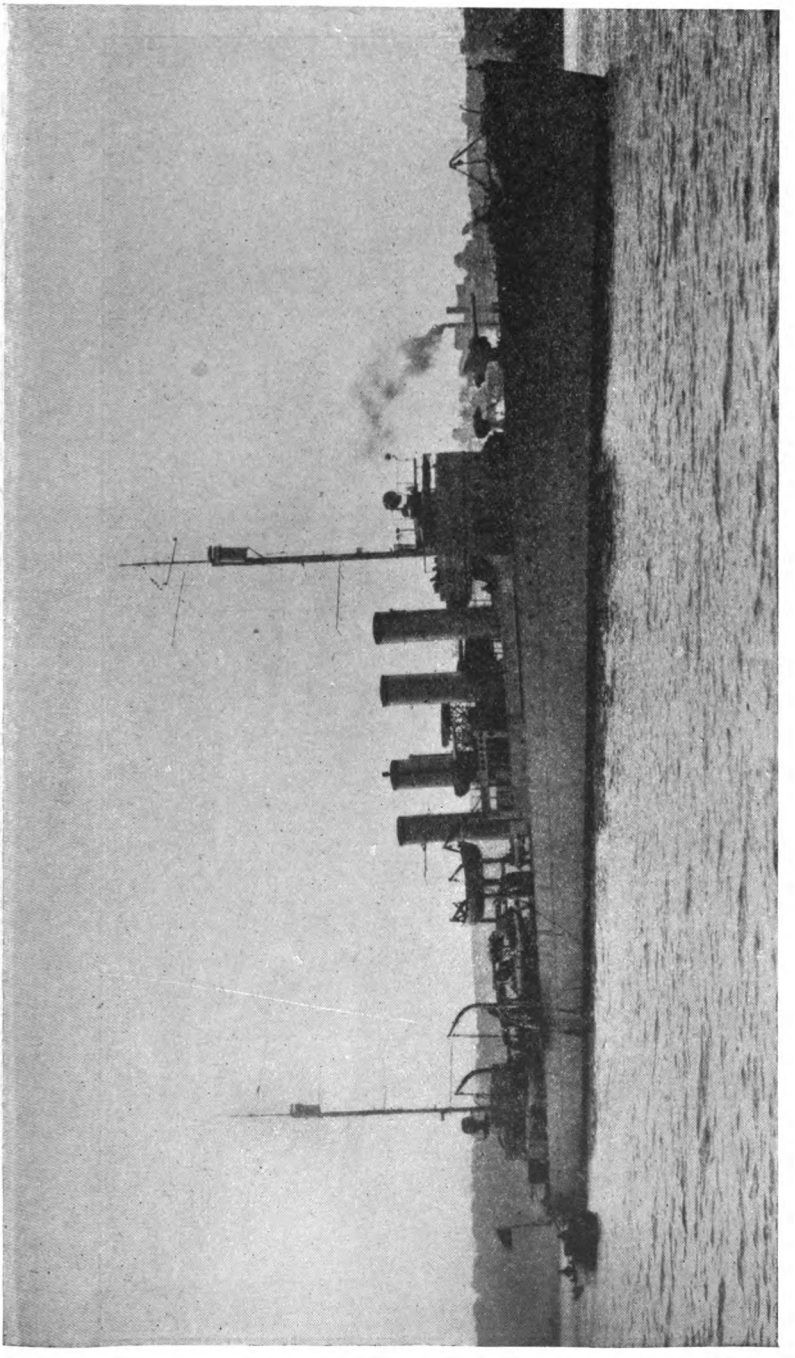
The *battle-cruiser* has the essential characteristics of the dreadnought battleship, but it is considerably longer and has considerably greater speed than the dreadnought. It carries very nearly the same number of guns and has very nearly the same armor protection as the recent types of dreadnoughts.



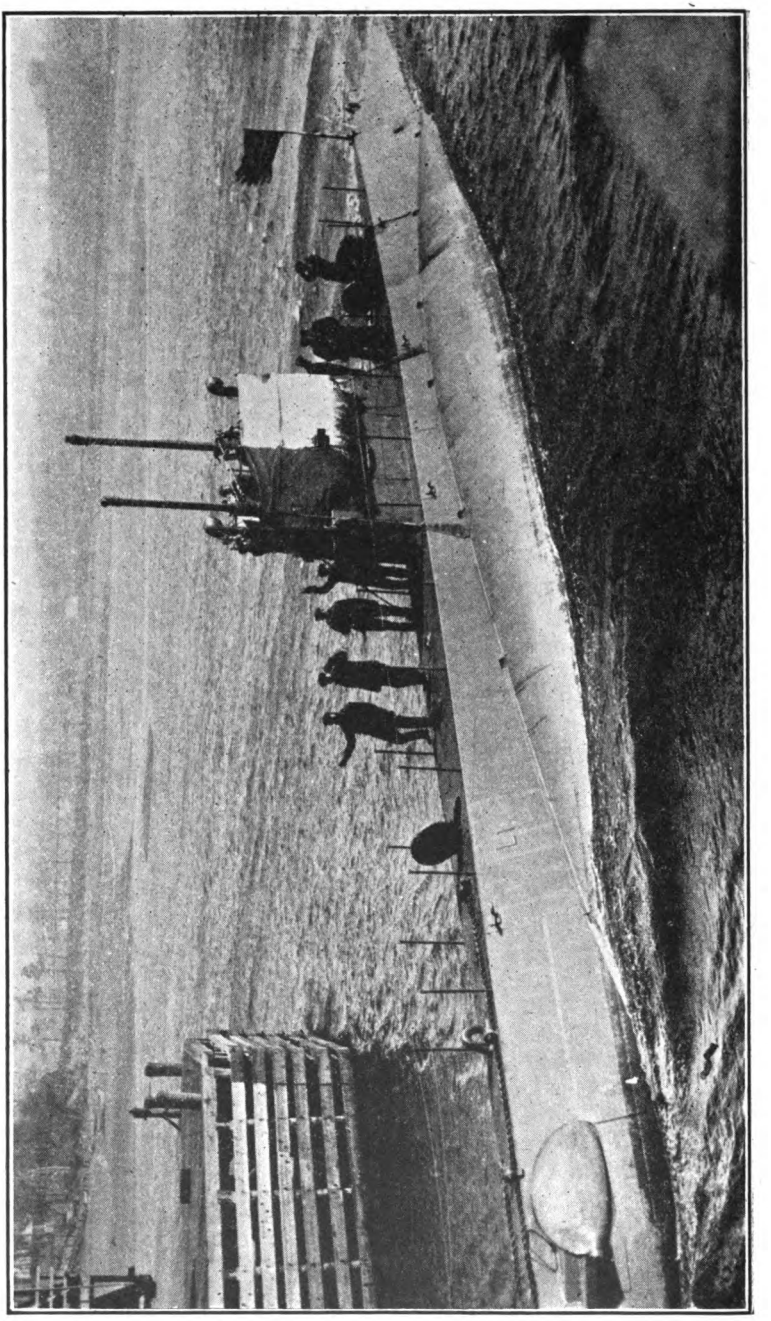
Photograph by Stephen Cribb, Southsea.

H. M. BATTLE CRUISER "QUEEN MARY"

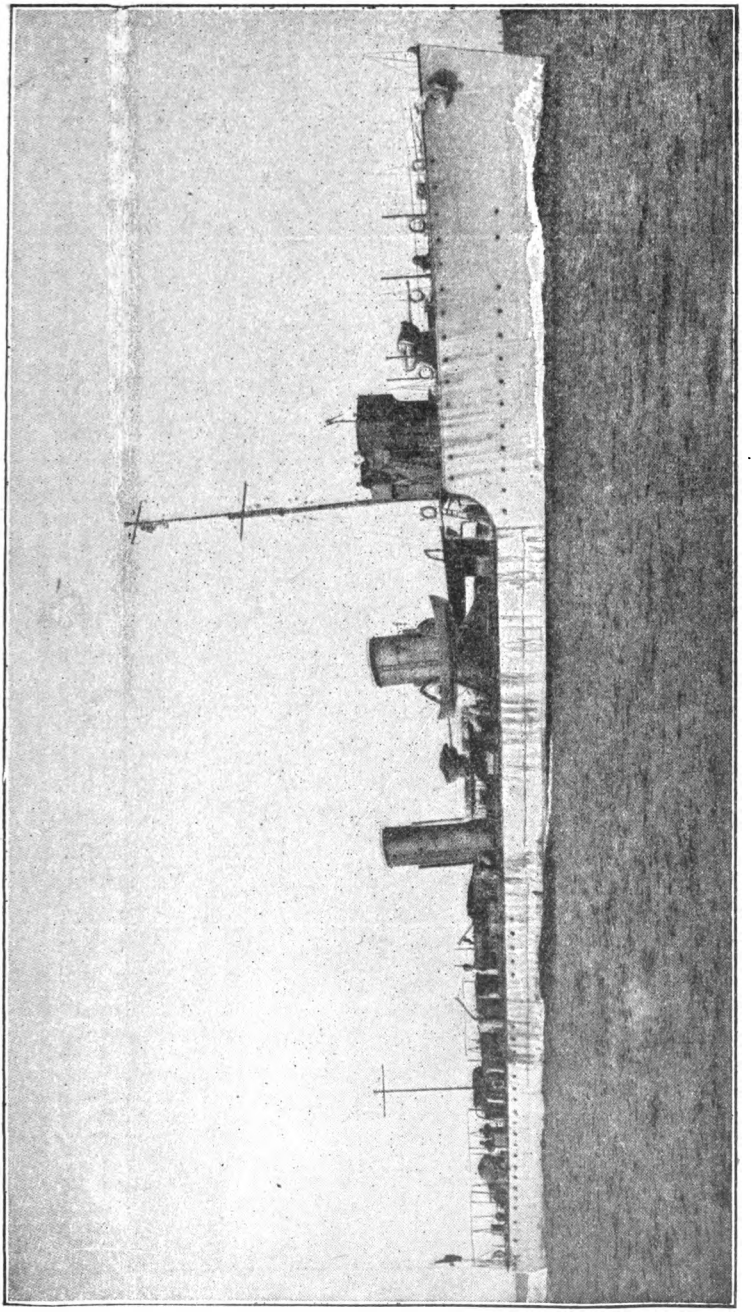
DISPLACEMENT, 27,000 TONS. BEAM, 89 FEET. DRAUGHT, 28 FEET. LENGTH OVER ALL, 698.5 FEET. ARMAMENT: 8 13.5-INCH GUNS; 16 4-INCH GUNS; 3 21-INCH TORPEDO TUBES. ARMOR: BELT, 9 INCHES (AMIDSHIP), 4 INCHES (ENDS); TURRETS, 9 INCHES; DECK, 3 INCHES. SPEED: DESIGNED 28 KNOTS; PROBABLE 34. PARSONS TURBINE.—LE YACHT, (PARIS)



ONE OF THE NEW FLUSH-DECK UNITED STATES DESTROYERS



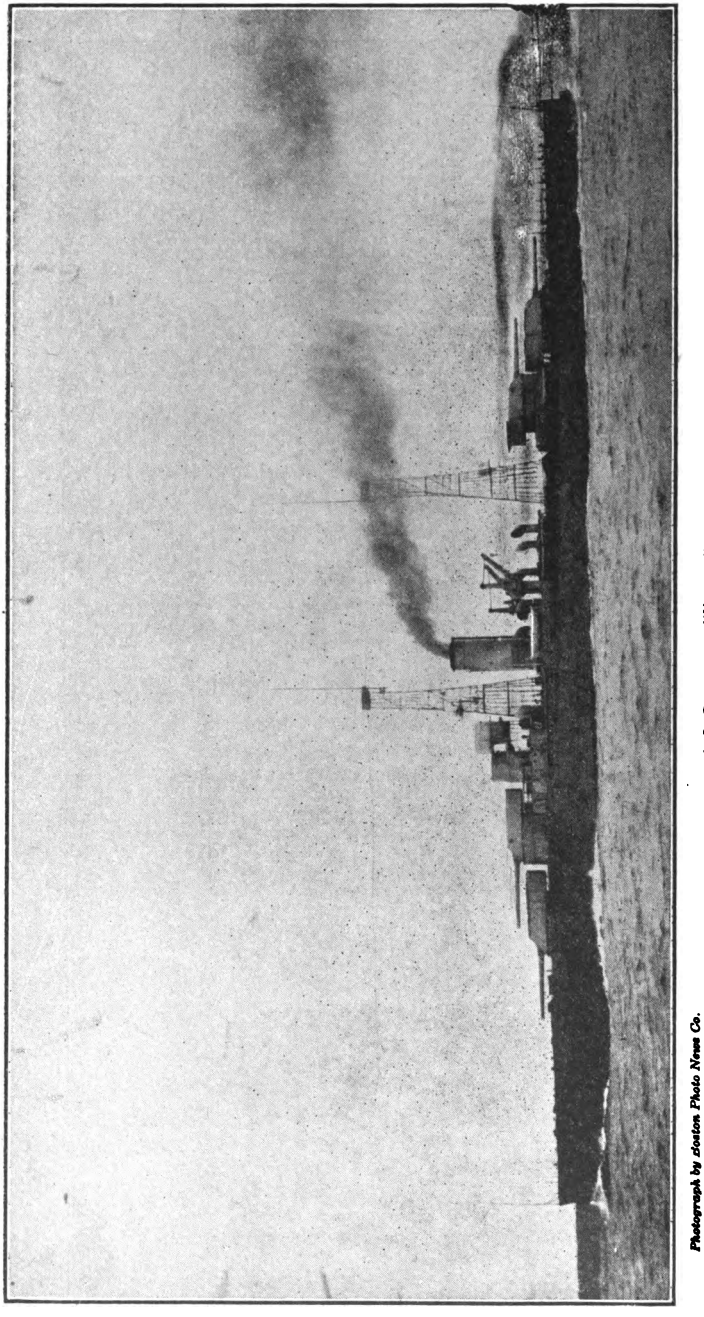
UNITED STATES SUBMARINE L-1



Photograph by Stephen Cribb, Southsea.

BRITISH DESTROYER LAUREL (L CLASS)

DISPLACEMENT, 907 TONS; ENGINES, 24,500 H.P.; DESIGNED SPEED, 35 KNOTS; THREE 4-INCH GUNS; TORPEDO TUBES, FOUR 21-INCH



Photograph by Boston Photo News Co.

U. S. BATTLESHIP "NEVADA"

COMPLETED JANUARY, 1916. FULL LOAD DISPLACEMENT, 29,000 TONS; LENGTH (WATER LINE), 575 FEET; BEAM, 95 1-4 FEET; MEAN DRAUGHT, 28 1-2 FEET; SPEED, 20.9 KNOTS
ARMAMENT: TEN 14-INCH, TWENTY-ONE 5-INCH, FOUR 3-PDRS. (SALUTING), TWO 1-PDRS, FOUR 21-INCH TORPEDO TUBES, SUBMERGED. COMPLEMENT, 893.

In some cases it is difficult to distinguish the battle-cruiser from the dreadnought battleship. Battle-cruisers are designed primarily for advance skirmishing, but they are capable of taking their place in the line of battle. The characteristic features are great size, great speed, heavy armor, heavy guns, massive appearance (although the lines are somewhat finer than those of a battleship), low freeboard, broad beam, and large turrets.

Of the *battleship* the characteristic features appear from what has been said above of the dreadnought.

The *armored cruiser* has the essential characteristics of the battleship, but its armor is lighter and extends over a comparatively smaller area, and its guns are fewer in number; its speed, however, exceeds by several knots that of the battleship of the same period. In other words, armor and armament have, to a certain extent, been sacrificed for speed. Its characteristic features are medium size, moderate speed, medium armor, medium guns, fine lines, high freeboard, medium beam, medium turrets.

Monitors are heavily armored and carry a limited number of guns of large caliber. They carry one or two turrets with guns of large caliber, have an extremely low freeboard, and have heavily armored sides. The maindeck is also armored. Speed and offensive power have been sacrificed for protection. The type has never been adopted except in the United States, and in this country it has fallen into disuse. It would be of value only in coast defense or harbor work. Its characteristic features are low speed, heavy armor, medium guns, very low freeboard, medium size, medium beam, medium turrets.

Protected cruisers differ essentially from armored cruisers in having no side armor, the protection consisting exclusively of a protective deck. Their purpose is to patrol the ocean, convoy merchantmen, prey on the enemy's commerce, and, in peace time, to show the flag and to serve as international police. Their characteristic features are small size, moderate speed, small guns, fine lines, high freeboard, narrow beam, large coal capacity, and guns mounted behind shields.

Scout cruisers have higher speed than any ships except torpedo craft (and some late battle-cruisers) and are intended to cruise in company with the fleet or precede the fleet for scouting. They are of light construction, and are armed with guns of power adequate only to repel small craft. Their characteristic features are great speed, small guns, fine lines,

high freeboard, narrow beam, no armor (generally), and guns behind shields.

Gunboats may be classed as small cruisers. They serve in peace time for patrol and police duty, and, in war time, for picket duty, etc. There are special types, called river gunboats, which are built with light draft for service up rivers and in shallow harbors. All have small size, low speed, no armor, high freeboard, and a few small guns.

Destroyers were originally built to operate against torpedo-boats, but soon appropriated to themselves the functions of the latter and are now, together with submarines, the chief medium of torpedo attack on large vessels. They are of extremely light construction and are built largely with a view to obtaining high speed. They have no armor, great speed, small guns (few in number and mounted behind shields), high bow, and torpedo tubes, and to reduce weight to a minimum they carry only necessities.

Torpedoboats were designed for torpedo attack on large vessels, are smaller than destroyers, and appeared first. They are no longer built and are used only in coast defense and harbor operations. Their characteristic features are great speed, small size, no armor, torpedo tubes, and few guns (small and behind shields).

Submarines are designed to operate beneath the water in torpedo attack, and have moderate speed, no armor, torpedo tubes, and no guns (although the latest types carry two rapid fire guns).

APPENDIX "A"

EXAMINATION FOR GUNNERS AND FOR SPECIAL RATINGS

Examination for Gunners

(Numbers refer to paragraphs in the 1914 Drill Regulations.)

806. Boards of examination will be convened annually in each coast defense command by the coast defense commander, to meet, if practicable, just prior to, or just after the close of the indoor instruction period. Separate boards may be convened for the examination of candidates for first and for second class gunners, and separate boards may be convened for the different forts in a coast defense command. Each board will consist of three coast artillery officers. When a member of the board is a company commander he will be relieved by another officer during the examination of candidates from his company.

807. For purposes of instruction and examination, enlisted men of the Coast Artillery Corps not belonging to companies or batteries, upon application, will be attached to convenient organizations, and upon qualification will be classified as gunners.

Enlisted men of the Coast Artillery Corps on duty outside of a coast defense command may be examined by one or more coast artillery officers with whom they are serving or by coast artillery officers designated by the department commander, and, if found qualified, will be announced as gunners by the department commander.

When a mine planter or cable ship is assigned to a coast defense command, the coast artillery enlisted men assigned to the vessel may be examined by the officers on duty with the vessel, and, if found qualified, will be announced as gunners by the coast defense commander.

808. A candidate to be eligible for qualification as first-class gunner must have qualified previously as second-class gunner, though both qualifications may be made at the same examination.

809. The examination of gunner candidates will be held, as far as practicable, at such places as the material pertaining to the subject in hand is located, and will be made as practical as possible. In determining the qualifications of candidates, credit will be given for practical knowledge of subjects, rather than for text-book answers to questions.

810. The qualifying mark for classification as first or second class gunner will be in each case not less than an average of 75 per cent. Whenever, during the progress of the examination of a candidate for either grade, the sum of the marks received on subjects for which he has already been examined, increased by the maximum allowed for the remaining subjects, is less than 75, he will be disqualified and his examination will be discontinued. Whenever, during the progress of the examination of a candidate for either grade, the sum of the marks received on the subjects in which he has already been examined is 75 or more, he will be qualified without any further examination.

811. The board will keep a record of its marks during the examination,

but these marks will not be published in orders. The report of the board on each company will be sent as soon as practicable after the completion of the examination to the coast defense commander, who will publish an order announcing the names of those who have qualified as first and second class gunners, and the date of qualification (the date of the completion of the company examination being taken as the date of qualification).

812. The scope of the examination for the first and second class gunners and the relative weights to be given the subjects will be as follows:

For candidates in companies assigned to coast defense:

For second-class gunners:

(*a*) Service of the piece (practical). This will include an actual drill at the battery in which the candidate will in turn perform the duties of various numbered cannoneers, the range setter, the chief of breech, the elevation setter (mortars only), and the azimuth setter (mortars only), or as many of those duties as the board may direct	40
(*b*) Nomenclature of the various parts of the gun and carriage	5
(*c*) Action, adjustment, and care of the various parts of guns and carriages	20
(*d*) Powders, projectiles, primers, and fuses	10
(*e*) Cordage, gins, shears, and jacks	10
(*f*) United States magazine rifle	15
	100

For first-class gunners:

(*a*) The azimuth instrument (theoretical, 5; practical, 10)	15
(*b*) Duties in the plotting room (theoretical, 20; practical, 30). The candidate will act in turn as Nos. 1, 2, 3, 4, and 5 while tracking a moving target (if practicable), or in as many of those positions as the board may direct	50
(*c*) Aiming and laying guns or mortars, practical	15
(*d*) Time-range board (guns) and time-azimuth board (mortars), practical	10
(*e*) Definitions, C.A.D.R.	5
(*f*) Warships, characteristic features	5
	100

The examination of candidates for first-class gunners of organizations assigned exclusively to rapid-fire guns not provided with separate position finding system will include the following head in lieu of those given under (*b*) and (*d*).

(*b*) (*d*) Subcaliber firing	60

The examination in subjects (*a*), (*b*), (*c*), and (*d*) for both second-class and first-class gunners will be confined to the materiel of that part of the defense to which the company is assigned. If no azimuth instrument is included in the battery equipment, the instrument used in the instruction will be used in the examination.

EXAMINATION FOR SPECIAL RATINGS

813. In each company of coast artillery, examinations will be held by the company commander under the direction of the fire or mine commander,

at such times as the latter may prescribe, for the purpose of determining enlisted men who are qualified for appointment to rated positions.

814. Records will be kept in each company in the form of eligible lists for each rated position to which enlisted men of the company may be appointed.

815. Examination for rated positions will be confined to first-class gunners or enlisted men who have once been classified as first-class gunners. Candidates who pass with an average of 75 per cent any of the examinations prescribed for rated enlisted men will be carried on the qualified list for appointment to the corresponding rated position for a period of one year from the date of examination.

816. Enlisted men on the qualified list for a rated position will be classified as first-class gunners from the date of qualification and so announced in coast defense orders, and such classification will be continued for the time they are entitled to remain on such qualified list. When a man's term of qualification for any rated position expires, he may be continued in such rated position or on the corresponding qualified list by passing a new examination for such rated position, and his classification as first-class gunner will be continued without further examination.

817. The same enlisted man may be carried on several qualified lists provided he passes satisfactorily the prescribed examinations for such rated positions.

818. Prior to the examination for the rated positions of observers, first or second class, or gun pointer, the candidates will be examined by the post surgeon for defective vision, and no candidate will be rated for these positions who has any defect in vision which would impair his efficiency.

819. An enlisted man holding a rated position need not be required to take the examination for that position until the termination of the one-year period from the date of his last classification as a first-class gunner, unless his qualifications for the position he holds have not been established to the satisfaction of the fire or mine commander concerned or the coast defense commander, in which case he will be required to take the examination for that position at such time as may be prescribed by the fire or mine commander concerned. In the event of his failure to pass satisfactorily the prescribed examination, he will be disrated immediately by the coast defense commander.

820. The scope of the examination for each of the rated positions will be as follows:

GUN COMMANDER AND GUN POINTER

I. Definitions C.A.D.R.

II. Gun and carriage.
  (a) Nomenclature, purpose, and action of several parts.
  (b) Packing stuffing boxes and cleaning recoil cylinders.
  (c) Adjustment of—
    Quadrant elevation device, sight standard, throttling valve, gas-check pad, elevating gear, grease cups, and firing mechanism.
  (d) Care and preservation, including care of hand counter-weights, oiling, and painting.

III. Powders, projectiles, fuses, and primers.
  (a) Blending powder and preparation of powder charges.

(*b*) Filling and fusing projectiles.
(*c*) Painting projectiles.

IV. Preparations for service or subcaliber practice.

V. Service of the piece.
(*a*) Duties of each member of the gun section under all conditions.

VI. Precautions for safety at the battery.

VII. Pointing.
(*a*) Methods of pointing and pointing tests.
(*b*) The telescopic sight (the quadrant for mortars).
(*c*) Emergency system and salvo points.
(*d*) Bore sighting and orientation.

VIII. Regulations governing service and subcaliber practice so far as they affect the service at the emplacements.

IX. Mounting and dismounting guns and carriages.

X. Characteristic features of the several classes of war ships, general knowledge of local shipping, of channels leading to the harbor, and of ranges to prominent fixed objects in the field of fire of the battery.

PLOTTER

I. Definitions C.A.D.R.

II. Position finding system.
(*a*) Detailed knowledge of system employed at the battery.
(*b*) Indication and identification of targets.
(*c*) Duties of each member of the range section under all conditions.
(*d*) Emergency system and salvo points.

III. Position finding apparatus.
(*a*) A detailed knowledge of adjustments and use of all position finding apparatus used in the plotting room.

IV. Elementary gunnery.
(*a*) Explanation of the several corrections to be applied to the observed range to obtain the corrected range.
(*b*) Effect on the flight of the projectile of variations in the density of the air; the direction and velocity of the wind.
(*c*) Use of trial shots and application of data obtained from them (problem).

V. Preparation of target-practice records.

OBSERVER (FIRST OR SECOND CLASS)

I. Definitions C. A. D. R.

II. Position finding system.
(*a*) Detailed description of that in use at the battery.
(*b*) Indication and identification of targets.
(*c*) Emergency system and salvo points.

III. Position finding apparatus.
(*a*) A detailed knowledge of adjustment and use of all observing instruments and range finders in use at the battery.
(*b*) Use of the telephone.

IV. Characteristic features of the several classes of war ships, general knowledge of local shipping, of channels leading to the harbor, and of ranges to prominent fixed objects in the field of fire of the battery.

APPENDIX "B"

Definitions

Note. These definitions are inserted here for the benefit of soldiers who wish to learn all they can of their profession. Instructors and examiners should not *require* the soldier to learn all of these definitions, but should be guided by the list of terms given in the body of the book under the head "Definitions" in the instruction for 1st class gunners; for an examiner to go beyond these limits (except in case of definitions learned in studying some other subject, as "fuses" or "primers") is to be unjust to the soldier.

These definitions are taken from publications of the Coast Artillery Board as they are more up to date than the definitions contained in the 1914 Drill Regulations, and presumably will eventually supercede the latter definitions.

Aeroscope.—A device used in the meteorological station and the fire, mine, and battery primary stations for the indication of the azimuth of the wind in degrees, the velocity of the wind and the density of the atmosphere by reference numbers. In the latter stations it may also contain a dial indicating the height of tide.

Aiming.—See **Pointing.**

Altitude.—Vertical distance above or below sea level or map datum.

Ammunition.—In general, is the term applied to all elements, including the projectile itself, used to send a projectile from the bore of a gun. **Round of Ammunition.**—Those elements used in firing a gun once. It is composed of:

Primer.—A device used to ignite the propelling charge.

Propelling Charge.—The explosive placed behind the projectile in the bore of the gun and used to impart motion to the projectile.

Projectile.—A missile thrown from a gun by the propelling charge to serve as a carrier for high explosives, gas, smoke, etc., which it is desired to carry to and explode or scatter at a definite point.

Bursting Charge.—The explosive placed in the cavity of the projectile and designed to explode with sufficient violence to rupture the shell and hurl the fragments with destructive effect.

Fuse.—A device attached to the projectile to cause the detonation of the shell at the time or under the circumstances desired.

Kinds of Ammunition.—The relation of the above elements of a round of ammunition to each other determines the kind of ammunition. This division is as follows:

Fixed Ammunition.—In which the primer, propelling charge, and projectile are in a single metal container, as in the Springfield rifle cartridge. This type of ammunition is used in 3-inch, 4.7-inch, 75-mm. guns and 37-mm. guns.

Semi-Fixed Ammunition.—In which the primer and propelling charge are in a single metal container, and the projectile is loaded separately. This type is used in the 4.7-inch howitzer.

Separate Loading Ammunition.—In which the primer, propelling charge, and projectile are each loaded as a separate unit. This type is used in guns of 5-inch caliber and up, 155-mm. gun, and howitzers of 8-inch caliber and up.

Ammunition Recess.—The space built in the parapet wall at loading platform level for the temporary storage of ammunition.

Ammunition Truck.—A truck for carrying projectiles to the breech of cannon.

Anemometer.—An instrument used in the meteorological station to determine the velocity of the wind.

Aneroid Barometer.—A watch-shaped instrument used in the meteorological station to determine the pressure or density of the atmosphere.

Angle of Departure.—The angle between the plane of site and the line of departure. The **Quadrant Angle of Departure** is the angle between the horizontal plane at the muzzle and the line of departure. Angles of departure are positive when measured upward from the horizontal plane.

Angle of Depression.—The angular depression of the line of site below the horizontal plane at the muzzle.

Angle of Elevation.—See **Elevation.**

Angle of Fall.—The angle between the horizontal plane at the point of fall and the line of fall.

Angle of Impact.—The angle between the line of impact and the plane tangent to the surface at the point of impact.

Angle of Incidence.—The angle between the line of impact and the normal to the surface at the point of impart.

Angle of Site.—The angle between the line of site and a line joining the piece and a point vertically above or below the target at an altitude equal to that of the piece.

Apron.—The reinforced concrete or metal portion of the superior slope of a parapet and the interior slope of a mortar pit designed to protect against blast. Also called **Blast Slope.**

Armament.—Cannon of various sizes and powers, including their carriages. In the Coast Artillery service armament is classified as primary, and secondary.

Armor.—The protection afforded the sides and decks of warships.

Armor Piercing Projectiles.—Shot and shell designed to perforate heavy side and turret armor of war vessels.

Atmosphere Board.—A device pertaining to the equipment of the meteorological station. A graphic table by means of which the reference numbers to be recorded on the dial of the aeroscope indicator can be determined from readings of the barometer and thermometer.

Axis of Gun.—The axis, or central line, of the bore.

Azimuth.—In harbor defense usage, a horizontal angle measured in a clockwise direction from the south point of the true meridian through the observer.

Azimuth, Y.—See **Y-Azimuth.**

Azimuth Difference.—The difference between the two azimuths of a point as measured from two other points.

Backlash.—The play between a screw and its nut where the latter is loosely fitted. A reverse movement of any part of a mechanical gear, caused by irregularities, without moving other connecting parts.

Baffle Plate.—A thin plate used to deflect or retard the course of gases of drill primers. It is attached to the front face of the breech-block.

Base Line.—In mobile warfare, the line joining the base piece and the base point. In harbor defense operations, a line used in position finding, the horizontal length and direction of which have been determined. The observing stations at the ends of a base line are called **Base End Stations.**

Base Piece.—In mobile warfare, the piece of a battery whose location is used in determining the firing data for the battery.

Base Point.—A well determined point in the field of fire of a battery at which the base piece is pointed in the original orientation of the battery.

Base Ring.—The metal ring which is bolted to the concrete of the emplacement and which supports the weight of the gun or mortar carriage.

Ballistics.—The science of the motion of projectiles and of the accompanying phenomena. **Interior Ballistics** deals with the motion of the projectile while in the cannon or small arm and with the physical and chemical phenomena that cause and attend its motion. **Exterior Ballistics** deals with the motion of the projectile in the air.

Battery.—One or more guns or mortars grouped with the object of concentrating their fire on a single target and of being commanded directly by a single individual, together with the entire structure erected for their emplacement, protection, and service.

Battery Manning Table.—A table containing a list of names detailing the personnel of a battery to their posts.

Battery Parade.—The area in rear of the emplacements of a battery where the sections form.

Battle Chart.—A chart used in fort, fire, or mine command stations,

showing the water area covered by the armament of their respective commands.

Biting Angle.—The maximum angle of incidence at which penetration of armor is secured.

Blending.—The process of mixing powders of the same or different lots so as to obtain charges of uniform characteristics.

Bomb-Proof.—A term applied to military structures of such thickness and strength that shells cannot penetrate them.

Bore.—The interior of the cannon forward of the front face of the breech block. (This face is that of the breech block proper, not including the mushroom head.) It is composed of the gas check seat, the powder chamber, the centering slope, the forcing slope and the rifled portion called the **Main Bore.** The **Length of Bore** is the distance from the front face of the breech block proper to the face of the muzzle measured along the axis of the bore.

Bore-Sighting.—In coast artillery, the process by which the line of sight and axis of the bore prolonged are caused to converge on a point at or beyond mid-range.

Bourrelet.—That part of a projectile between the main body and the head, which includes the beginning of the ogive.

Breech.—The rear end of a cannon. In small arms, the rear end of the barrel.

Breechblock.—The metal plug which closes the breech of a cannon.

Breech Bushing.—That part of the breech on the interior surface of which the threaded and slotted sectors of the breech recess are formed.

Breech, Face of.—The rear plane of a cannon perpendicular to the axis of the bore.

Breech Mechanism.—The breechblock, obturating device, firing mechanism, and all parts used in operating the breechblock of a cannon.

Breech Recess.—The opening in a cannon which receives the breechblock.

Breech Reinforce.—The part of a cannon in front of the breech and in rear of the trunnion band.

Bushing.—(Machine). A hollow cylinder forced into an opening to provide a better wearing surface, or one that may be easily replaced when worn.

Caliber.—The diameter of the bore in inches, measured between diametrically opposite lands. It is the minimum diameter of the rifled portion of the cannon.

Cannon.—Artillery weapons from which projectiles are thrown by the force of expanding powder gases. (See Gun or Piece.)

Cannon are of three classes: Guns, mortars, and howitzers.

Guns are long (generally 30-50 calibers), have flat trajectories, and are ordinarily used for direct fire, with high velocities.

Mortars are short (about 10 calibers), and are used for high-angle fire (above 45°), with low velocities.

Howitzers are short guns and are used for curved fire (not exceeding 45°), with low velocities.

Built-up cannon are made by shrinking forgings (jacket and hoops) over an inner tube. Wire-wound cannon are made by winding wire under tension around a tube; a jacket and hoops may be shrunk over the wire-wound tube.

Cannoneer.—Any man employed in the "service of the piece."

Cap-Square.—That part of a gun or mortar carriage which fits over the trunnions and holds the trunnion in the trunnion bed.

Capped Projectile.—A projectile having a metal cap over its point to give stability to the point of **Armor Piercing Projectiles** when commencing penetration and to give the armor an initial shock at the point of penetration, or to cut down the air resistance of projectiles provided with **a ballistic cap.**

Carriage or Mount. The means provided for supporting a cannon. It includes the parts for giving elevation and direction, for taking up the recoil on discharge and for returning the piece to the firing position.

Carriage, Fixed (Seacoast).—A mount provided for guns and mortars in permanent works and not designed to be moved from place to place.

Those used for fixed coast artillery cannon may be divided into the two following classes, depending upon the nature of cover afforded by the emplacements.

Barbette: Where the gun remains above the parapet for loading and firing. Barbette carriages are used for guns of 3-inch or greater caliber. The pedestal mount is a type of barbette carriage used for guns up to 6-inches in caliber.

Disappearing: Where the gun is raised above the parapet for firing and recoils under cover for loading. This mount is used for guns of 6-inch or greater caliber.

Cant.—The angle made with the horizontal by the axis of the trunnions, sometimes referred to as **slope of the trunnions.**

Calibration.—The determination of the range and deflection differences to be expected when firing two or more cannon under identical conditions of atmosphere, range and direction. Calibration corrections are the corrections necessary to compensate for these differences.

Carriages, Mobile (Seacoast).—A mount provided for guns, howitzers and mortars that is so designed that it is capable of being moved from place to place. These carriages include the following types, railway, wheel, caterpillar, truck and self-propelled mounts.

Cartridge.—A complete load of fixed ammunition (projectile, powder, and primer) as used in small arms.

Cartridge Bags.—Bags used to hold the powder charges for cannon.

Cartridge Case.—A container in which powder is sealed for shipment and storage.

Cartridge Extractor.—That part of a breech loading gun which ejects the empty cartridge case from its seat in the bore.

Casemate.—An obsolete form of bombproof chamber, usually of masonry, in which cannon were placed to be fired through embrasures or portholes; or one capable of being used as a magazine. See **Mining Casemate.**

Center of Impact.—The mean position of the points of impact of a series of shots.

Centering Slope.—The conical part of the bore between the powder chamber and the forcing slope. It is for the purpose of bringing the axis of the projectile in line with the axis of the bore.

Charge.—The explosive placed in a gun or mortar behind the projectile as a propellant (propelling charge). Also the explosive placed in the cavity of a projectile (bursting charge).

Charge (or Powder) Section.—One of the component parts of a charge when the charge is made up of two or more separate parts.

Chase.—That part of a cannon in front of the trunnion band.

Chassis.—That part of a gun carriage upon which the top carriage moves backward and forward. With the disappearing type of carriage the chassis carries recoil rollers and the top carriage rests upon these rollers.

Chronograph.—An instrument for graphically representing elapsed intervals of time.

Chronometer.—An instrument for accurately measuring time.

Circular (Traversing, Elevating, etc.) Rack.—A straight or slightly curved bar with teeth on its edge arranged to mesh with those on a wheel or pinion, which is to drive or follow it.

Clinometer.—An instrument for measuring accurately the inclination of the axis of the bore to horizontal.

Clinometer Rest.—The support for a clinometer inserted in the muzzle of the gun; it is also called **Bore Plug.**

Collar.—(Machine). An enlarged cylindrical portion of a shaft, or a cylindrical ring or sleeve secured upon the shaft, in either case to serve as an abutment for securing something or preventing longitudinal movement of the shaft itself.

Combustion.—The burning of a grain of powder or wood or coal, from the surface of ignition inward or outward or both.

Communications.—Means of transmitting orders or messages through the tactical chain of artillery command. In another sense it includes all routes, such as roads, railroads, etc., by which an army communicates

with its base, or by which several parts of an army communicate with each other.

Corridor or Truck Corridor.—The elevated passageway in rear of the traverse connecting adjacent gun emplacements at the loading platform level.

Counterweight.—The weight used in bringing a gun on a disappearing carriage to the firing position, and to take up part of force of recoil. The pit in the gun platform for the reception of the counterweight is called the counterweight well.

Critical Dimension.—A term used in connection with powder grains. It is the dimension or thickness of the web between the perforations in a multi-perforated grain. Also called **Least Dimension.**

Crusher Guage.—A device inserted in the mushroom head of the breechblock, or in the bottom of the bore, to determine the maximum pressure of the bore. Commonly called **Pressure Guage.**

Danger Space.—The part of the range within which a target of a given height would be hit by a projectile. The maximum which is all danger space is called the **Danger Range.**

Datum Point.—A fixed point, the azimuth and range of which, from one or more observing stations, have been accurately determined.

Deflection.—The angle between the sighting plane and the vertical plane through the axis of the bore.

Deflection Board.—A device for determining the algebraic sum of the deflection corrections for wind, drift and travel of target during the time of flight and the predicted interval. It is used to determine the reference numbers for the deflection scale of the sight in Case I and II, and the azimuth correction reference number in Case III; and, for mortars, the corrected azimuth.

Deflection Scale.—A scale provided on sights, graduated in degrees or mils for the purpose of laying the piece in direction or obtaining and applying correction for deflection.

Degree.—One three-hundred-and-sixtieth part of a circumference. Thus 90 degrees make a right angle.

Delivery Table.—The hoist table from which the projectiles are delivered to the ammunition trucks.

Density of Loading.—The ratio of the weight of the powder charge to the weight of a volume of distilled water at the temperature of maximum density (39°.2. F.) which will fill the powder chamber. The formula for computing it is

$$\Delta(\text{density of loading}) = 27.68\ w/v,$$

in which w is equal to the weight of the powder in pounds and v the volume of the chamber in cubic inches.

Detonation.—An explosion in which the conversion takes place with rapidity producing a crushing or shattering effect.

Deviations.—Divergences (or components thereof) with respect to the center of the target, of points or centers of impacts or of points where trajectories pierce a reference plane. Deviations should be differentiated from errors which are divergences of shots with respect to the center of impact.

Difference Chart.—A graphic device by means of which the range and azimuth of a target from one gun or station are obtained when the range and azimuth from some other gun or station are known.

Directing Point.—In harbor defense, a point for which the basic position or firing data is determined. When the pintle center of one piece is taken as the directing point of a battery such piece is called a **directing gun.**

Dispersion.—As generally used in gunnery, dispersion is the distribution of points of impact about their mean position or center of impact.

Dispersion Ladder.—A diagram of eight successive sections each equal in width to one probable error, and two unlimited end sections with percentages marked as follows:

½% 1½% 7% 16% 25% 25% 16% 7% 1½% ½%

This indicates the approximate per cent of impacts to be expected in each section when the center of impact is the center of the diagram.

Drift.—The divergence of the projectile from the plane of departure due to the rotation of the projectile and the resistance of the air. Where

the twist of the rifling is right handed, as in our service, the resultant drift is always to the right. It may be expressed either in linear or angular units.

Elevating Band.—A band around a gun near the breech to which are attached the elevating arms. By means of the elevating gearing, the elevating arms give elevation to the gun.

Elevation.—The angle between the plane of site and the line of elevation. Positive when measured upward from the plane of site. Symbol φ', read **phi prime. Quadrant Elevation** is the angle between the horizontal plane at the piece and the line of elevation; positive when measured upward from the horizontal plane. Symbol φ, read **phi.**

Emplacement.—That part of the battery pertaining to the position, protection, and service of one gun, mortar, or group of mortars.

Equalizing Pipe.—A pipe connecting the corresponding ends of two recoil cylinders for the purpose of equalizing the pressure therein.

Erosion.—The gradual enlargement and scoring of the bore due to the action of powder gases on the metal of the lands and grooves. (In foreign armies *erosion* as here defined is referred to as the *wear of the gun* and the term *erosion* is used to designate deep and sudden pittings of the bore.)

Errors.—Divergences (or components thereof) with respect to the center of impact of points of impact or of points where trajectories pierce a reference plane. Errors should be differentiated from *deviations* which are divergences of points of impact or centers of impact with respect to the target.

Explosive.—Any substance by whose decomposition or combustion, gas is generated with great rapidity. Military explosives consist of solids or liquids which, through the application of heat or shock, are susceptible of being converted suddenly into gases through chemical reactions.

Explosive Compound.—An explosive whose ingredients are united chemically. Nitro-glycerine and guncotton are explosive compounds.

Explosive Mixture.—An explosive whose ingredients are mixed mechanically. Gunpowder is an explosive mixture.

Explosion.—Rapid conversion of a substance into a large volume of hot gases and solids.

Exterior Crest.—The line of intersection of the superior and exterior slopes.

Exterior Slope.—The outer slope of the parapet of a battery.

Field of Fire.—The area covered by the armament of a battery, or with reference to a single gun, it is the area covered by that gun.

Fifteen-Pounder.—Term applied to a 3-inch rapid fire gun. It denotes the proper weight of projectile for the piece.

Fifty Per Cent Zone.—A zone bounded by two parallel lines equidistant from the center of impact and one probable error therefrom. Fifty per cent of the points of impact of a series of shots fired under uniform conditions with uniform pointing may be expected in such a zone. (See dispersion ladder). The area common to the fifty per cent lateral zone and the fifty per cent longitudinal zone is the **Twenty-Five Per Cent Rectangle.**

Fire Control.—The exercise of those functions of command connected with the concentration and distribution of fire, including the assignment and identification of targets. Ordinarily **fire control** is exercised by fire, battalion or other higher commanders. When battery commander's action is ordered, or becomes necessary, battery conmanders exercise independent fire control.

Fire Control Diagram.—A diagram showing the assignment of batteries to fire or mine commands, the division of fort commands into fire and mine commands, the assignment of searchlights, and the system of communications for the tactical chain of command in any particular coast defense command.

Fire Control Installation.—The materiel after installation which is employed in the fire control, fire direction and position finding service of any unit is called the **fire control installation of that unit.**

Fire Direction.—The exercise by the commander of a battery or other fire unit of those functions of command necessary to secure accuracy of fire on an assigned target.

Fire Discipline.—The efficiency of the personnel in action which

involves accuracy and alertness resulting from organization, drill and coordinated effort.

Fire, Kinds of:

(a) **Direct Fire.**—Fire with angles of elevation not exceeding 20°.

(b) **Curved Fire.**—Fire with angles of elevation from 20° to the elevation corresponding to the maximum range.

(c) **High Angle Fire.**—Fire with angles of elevation greater than the elevation corresponding to maximum range.

(d) **Indirect Fire.**—A term sometimes used in the light artillery service to designate fire by indirect pointing.

Fixed Mount.—A mount or carriage provided for guns and mortars in permanent works and not designed to be moved from place to place.

Fixed Light.—A searchlight intended to demarcate the outer limit of a battle area and illuminate any target entering it.

Forcing Slope.—The part of the bore immediately in front of the centering slope. The rifling begins at the junction of the centering slope and the forcing slope. The tops of the lands at this point are cut down so that less power is required at first to force them through the copper rotating bands. The lands attain their full height at the front end of the forcing slope.

Fork.—The change in elevation necessary to produce a change in range equivalent to four times the field range probable error.

From Battery.—The position of a gun when withdrawn from its firing position.

Fulminate.—A very sensative explosive compound used in fuses, primers and caps.

Fuse.—A device attached to a projectile for the purpose of causing the explosion of the bursting charge either by impact or at the expiration of a certain time of flight. Fuses are classified according to construction, as ring resistance, combination, time and percussion, centrifugal, and detonating; they are classified according to location in the projectile as point and base.

Gallery.—Any passage covered overhead and at the sides.

Garrison Gin.—A lifting tackle used in mechanical maneuvers of coast artillery armament.

Gas Check.—The essential mechanical features of an obturator which enables it to prevent the escape of gas.

Gas Check Seat.—That part of the bore of a cannon where the gas check pad rests when the breechblock is closed.

Gearing.—A train of toothed wheels for transmitting motion.

Spur Gear.—A gear with a cylindrical pitch surface, the faces of the teeth being parallel to the axis of the wheel; used for transmitting motion between parallel shafts.

Bevel Gear.—A gear with its pitch surface a frustrum of a cone; used for transmitting motion between two shafts which would intersect if prolonged.

Worm Gear.—A gear of a worm and a worm wheel working together.

Grooves.—In ordnance, the spiral hollow cuts made in the surface of the bore.

Gun or Piece.—A general term applied to any firearm from which a missile is propelled by the force of expanding gas. In a restricted sense, the term **gun** is applied as defined under **cannon.**

Gun Displacement.—The horizontal distance in yards from the vertical axis of the directing gun to the center of any other gun of the battery, or from the directing point to the center of any gun of the battery.

Gun Levers.—Two steel arms on a disappearing carriage which support the gun at one end and the counterweight at the other end. The gun trunnions rest in trunnion beds on the gun levers, and the counterweight is suspended from a steel crosshead which joins the ends of the gun levers. The gun levers are pivoted near their middle upon a gun-lever axle which rests in bronzed bushed axle beds in the top carriage.

Gun Platform.—That part of a battery upon which the gun carriage rests.

Gun Pointer.—A specially qualified member of a gun section charged

with the proper aiming or laying of a gun, or the chief of a mortar detachment who supervises the loading and laying of a mortar.

Gunner's Quadrant.—An instrument usually used in laying mortars to give quadrant elevation by either applying it at the breech or muzzle.

Gunnery.—The art and science of operating guns.

Height of Site.—The altitude of a piece above or below the assumed datum; for cannon emplaced to cover water areas, their altitude above mean low water, except in the Pacific insular possessions where the datum is mean lower low water.

Hoop.—A forging superimposed upon the jacket, tube or other hoops of a cannon.

Hygrometer.—An instrument for measuring the degree of moisture in the atmosphere.

Ignition.—The setting on fire of a powder grain or charge.

Igniting Charge.—A charge of black powder placed in contact with the propelling charge to quicken inflammation; a **base igniter** if quilted into each end of each charge, and a **core igniter** in the form of a tube connecting both ends of a charge.

In Battery.—The term used to indicate that a gun is in its proper position for firing.

In Commission.—The term used to indicate those batteries to which personnel is assigned.

In Service.—The term used to indicate those batteries to which personnel is assigned and at which daily drills are held.

Inflamation.—The spread of the flame from grain to grain of the charge, or point to point of the grain.

Initial Velocity.—See muzzle velocity.

Interior Crest.—The line of intersection of the interior wall or slope with the superior slope.

Interior Slope or Wall.—The inner slope or wall of gun parapets or mortar pits.

Jacket.—The principal forging shrunk on the breech end of a tube of a cannon.

Journal.—The portion of a shaft or axle which works within the bearings.

Journal Box.—(Ry). A cast iron box which contains the car axle journal, together with the journal bearing, oil packing, etc.

Lands.—In ordnance, the surface or ribs of the bore between two adjacent grooves of the rifling.

Lanyard.—A strong cord to one end of which a brass hook is attached. Used for exploding the friction primer when the piece is to be fired. See **Safety Lanyard.**

Lateral Fork.—The change in deflection necessary to produce a lateral displacement of the point of impact equivalent to four times the field deflection probable error.

Line of Collimation.—The line in which the optical axis of the telescope should be when properly adjusted. The line of collimation and the line representing the axis of the telescope, when in proper adjustment, coincide.

Line of Site.—A straight line joining the piece and target.

Load.—A single charge of powder and a single projectile as combined for firing in a gun or mortar.

Loading Platform.—That surface upon which the cannoneers stand while loading the piece.

Loading Tray.—A device used to protect the breech recess while loading the projectile.

Lot.—A term used by manufacturers to designate a certain amount of explosives manufactured at one time. All of the explosive of one lot should possess uniform characteristics.

Magazine.—A room for storage of powder, primers, fuses, etc.

Maneuvering Rings.—Large cast iron rings fastened in the walls of emplacements, designed for holdfasts in mechanical maneuvers.

Mark One.—A term used to indicate the first improvement of the original model of a particular type of gun, mortar, etc.

Map Range.—The range of any point as scaled or calculated from a map.

Maximum Ordinate.—The difference between the altitude of the piece and the summit of the trajectory.

Mercurial Barometer.—An instrument used in the meteorological station to determine the pressure or density of the atmosphere.

Meteorological Message.—The message sent by a meteorological observer. It includes the barometer and thermometer readings, the atmosphere reference numbers and the velocity and azimuth of the wind.

Meteorological Observer.—An enlisted man in charge of the meteorological station.

Meteorological Station.—A station containing instruments for obtaining and sending out to the various stations data relating to the density of the atmosphere and the velocity and direction of the wind.

Mil.—One sixty-four hundredth part of a circumference. Thus 1600 mils make one right angle or 90°.

Mining Casemate.—A protected building containing the controlling mechanism of the mine defense.

Misfire.—The failure of a powder charge to explode. In case of a misfire in artillery practice the breech will not under any circumstances be opened for ten minutes, nor until the primer has been removed except when the primer is seated in the cartridge case.

Mushroom Head.—The front part of the DeBange obturator.

Muzzle.—The front end of a piece.

Muzzle (or Initial) Velocity.—The velocity the projectile is assumed to have at the muzzle of the piece. Strictly it is the velocity at the muzzle which if there were no powder blast would conform to the actual velocities measured at points of the trajectory beyond the powder blast distance. Symbol, M.V.

Nitrocellulose Powder.—The name applied to a form of smokeless powder used in modern ordnance, in which cellulose (unspun cotton waste) is the base.

Object Glass.—The glass in a telescope which is placed at the end of the tube nearest the object.

Observation Telescope.—A telescope used in target practice and in action to observe the striking points of shots.

Observer.—A member of the fire control section who is in charge of and uses an observing instrument.

Obturator.—A device for preventing the escape of gas. **Obturation** is the process of preventing the escape of gas.

Ogive.—That curve at the head of a projectile which terminates at the point.

Ordnance.—The term applied to artillery armament and the accessories and stores pertaining thereto.

Orienting Point.—A point at which an azimuth instrument may be set and from which the Y-azimuth of at least one visible point is known.

Parados.—Earthworks in rear of a battery for protection against fire from the rear. It may have interior, superior, exterior and traverse slopes.

Parapet.—That part of a battery, composed of earth, timber, stone, metal, etc., which gives protection to the armament and personnel from front fire.

Pattern.—The group of points of impact of a salvo.

Penetration.—The act or power of penetrating armor or other material. Also the distance to which a projectile sinks into armor or other material.

Perforation.—The complete piercing of armor or other material by a projectile. This term as distinct from *penetration*, defines the ability of the projectile to pass through armor or other material so as to be in position to burst on the opposite side.

Percussion Cap.—A cap in which the method of explosion is due to a blow; used in fixed ammunition.

Piece.—See Gun or Piece.

Pintle Center.—The vertical axis about which a gun carriage is traversed.

Pinion.—A small toothed wheel in gear with one considerably larger.

Piston.—A device for receiving the pressure of, or operating upon, a

fluid in a cylinder or tube, and consists of the piston head, and the piston rod.

Pit.—That part of a mortar emplacement designated for mounting one or more mortars, usually two or four.

Plane of Departure.—The vertical plane containing the line of departure. This plane is also called the **plane of fire.**

Plane, Sighting.—The vertical plane containing the sighting line.

Plane of Site.—The plane containing the line of site and perpendicular to the vertical plane through the line of site.

Plotter.—A specially qualified enlisted man in charge of the plotting board at a fire control station.

Plotting Board.—A device used in the position finding service to quickly plot to scale the data sent from the position finding instruments, and in connection with range and deflection boards, to determine the corrected data for firing.

Plotting Room.—The room in which the plotting detachment works. It is usually located below and communicates with, the instrument room of the battery commander's station, or with the observing room of the primary station.

Point of Burst.—The point in the air where a projectile bursts or where in uninterrupted flight it would burst by the action of a time fuse.

Point of Impact.—The point where an unburst projectile first strikes the ground, the water or other material object.

Pointing.—The operation of giving a piece an elevation and a direction designed to hit a rarget. When pointing in direction, or in both direction and elevation, is effected by the use of a sight such operations are called **Aiming.** When pointing in elevation, or in both elevation and direction, is effected without the use of a sight such operations are called **Laying.** Thus both aiming and laying may be employed in a single pointing. When the sighting plane passes through the target, the piece is said tobe directly aimed, i.e., **Direct Aiming** is used. When the sighting plane passes through an auxiliary point, the piece is said to be indirectly aimed, i.e., **Indirect Aiming** is used. **Indirect Pointing** includes both **laying** and indirect aiming

Position Finder.—An instrument for locating a target.

Position Finding System.—The term applied to the system used in determining the range and direction of a target from a battery or directing point. The following systems are used in the Coast Artillery service, horizontal base, vertical base, and self contained base.

Powder Blast.—The outrush of air, gases and powder fragments from the muzzle when a piece is fired.

Powder Cases.—Cases in which powder is contained in shipment from arsenals or storage until used.

Powder Chamber.—The portion of the bore for the reception of the powder charge. The **Closed Powder Chamber** includes the total enclosed space occupied by powder, air and powder gases at the instant of firing.

Powder Chart.—A graphic chart used to determine the velocity to be expected from a given charge of powder considered as a function of the temperature of the powder.

Powder Hoist.—A device for raising powder from the magazine to the loading platform.

Power Room.—A room in the battery provided for the necessary motor generators, induction motors and switchboards.

Power Station or Plant.—The principal source of supply of energy, usually electrical, for the power system of the fortifications and stations. The plant consists of a sufficient number of direct connected units to supply all the power needed for the entire installation under conditions of full load.

Predicted Point.—A point at which it is predicted that a target will arrive at the end of an assumed interval of time. This interval of time is called the **Predicting Interval.**

Predicter.—An accessory of the plotting board used to locate the positions of the predicted and the set-forward points on the plotting board.

Preponderance.—The excess (moment) of weight of that part of the piece in rear of the trunnions over that of the front, or the converse. It

is measured by the force expressed in pounds necessary to balance the cannon when resting freely on the trunnions.

Pressure Cylinder.—A soft copper cylinder used in crusher guages which is compressed by the explosion of the charge.

Pressure Guage.—See **Crusher Guage.**

Primary Armament.—The armament of the coast artillery service consisting of major caliber cannon. It includes 12-inch, 14-inch and 16-inch guns, and howitzers and mortars 12 and 16 inches in caliber.

Primer.—The device used for igniting the propelling charge. Primers may be friction, percussion, electric, or combination (electric and friction).

Priming Charge or Igniter.—Small charges of black powder placed in contact with the powder sections necessary for the ignition of smokeless powder (See **Igniting Charge**).

Projectile.—The term applied to a missile thrown from a firearm by an explosive. The principal parts of an armor-piercing projectile are the ballistic cap, the armor-piercing cap, the nose or point, the ogive, the bourrelet, the body, the rotating band, the cavity, the base, the base plug, and the fuse plug.

Progressive Powder.—An explosive or propelling agent of low order; for example, the charcoal and nitro-cellulose powders. The explosion of powders of this kind is marked by more or less progression. The mass is ignited at one point and the combustion proceeds progressively over the exterior exposed surfaces and then at right angles to these surfaces.

Projector.—The technical name of a searchlight.

Pyramidal Target.—A material target in the form of a pyramid, covered with canvas painted vermilion. This pyramid is mounted on a float made of two parallel sills of timber, joined by transoms, two diagonal braces and a prow to which a suitable bridle is attached for towing.

Quadrant.—The quarter of a circle or the quarter of the circumference of a circle; an arc of 90 degrees. Also an instrument by means of which a gun is laid in elevation.

Quickness of Burning.—The rapidity with which a grain of powder is consumed. When it is said that the powder is too quick or too slow for a gun, the quickness of burning through the "critical dimension" of the grain is referred to.

Racer.—That part of a seacoast gun or mortar carriage which rests upon the traversing rollers. On gun carriages the chassis is bolted to the racer, and on mortar carriages the side frames are bolted to the racer.

Rammer.—A rod provided with a graduated brass ring; used for properly seating a projectile in the bore of seacoast cannon.

Ramp.—An inclined plane or foot path, serving as a means of travel from one level to another.

Rampart.—A broad embankment of earth around a place upon which a parapet is raised. A structure forming the substratum of every permanent fortification.

Range.—In a limited sense, the horizontal distance from the cannon to the target. In a general sense it is applied to horizontal distances between position finder and target, position finder and point of impact, cannon and point of impact, etc. The range of a shot is the horizontal distance from the cannon to the point of impact. The range appearing in the latest range tables and used in ballistics is the distance from the cannon to the point of fall measured along the surface of a sphere concentric with the earth and passing through the cannon. The range appearing in older range tables is the horizontal distance from the cannon to the point where the descending branch of the trajectory pierces the horizontal plane through the cannon.

Range-Azimuth Table.—A table of ranges and the corresponding azimuths from a gun to points in the center of the main ship channel or channels. It is kept at the gun and used for firing without the use of the range finding apparatus.

Range Board.—A device for obtaining the range corrections which must be made for wind, atmosphere, tide, and velocity.

Range Finder.—An instrument for determining the range to a target or object, from some fixed point.

Range Setter.—A specially qualified member of the gun section who lays the gun for range.

Range Table.—A compilation of data chiefly in tabular form intended to furnish the ballistic information necessary for directing the fire of a specified model of cannon with specified ammunition.

Rapid Fire Gun.—A single barrel breech-loading gun provided with breech mechanism, mounting, and facilities for loading, aiming, and firing with great rapidity. The breech mechanism is operated by a single motion of the handle or lever. The smaller calibers use fixed ammunition.

Rated Men.—Enlisted men who have passed examinations for the positions and who have been rated by the coast defense commander as gun commanders, gun pointers, observers, plotters, casemate electricians, chief planters, chief loaders, and coxswain.

Recoil.—The backward movement of the piece on firing. **Counter-recoil** is the forward movement of the piece in returning to battery.

Receiving Table.—The hoist table on which projectiles are placed preparatory to raising.

Recoil Cylinders.—Hydraulic cylinders for controlling the recoil.

Recoil and Counter-Recoil Buffers.—Devices on gun carriages for the purpose of reducing the shock due to abnormally excessive recoil or counter-recoil.

Reference Numbers.—The numbers used in the graduation of some of the scales of instruments employed in gunnery. The reason for their use is to avoid the liability to error that arises from the use of *right* and *left* in deflection corrections, and of *plus* or *minus* in range corrections.

Referring Point.—An auxiliary aiming point pertaining to only a portion of the pieces of a battery.

Registration Point.—A point on which fire is adjusted with a view to delivering more accurate fire on adjacent points.

Relocation of Target.—A process whereby the range and direction of a target from one point may be obtained without observation when the range and direction of the target is known from some other point.

Remaining Velocity.—The velocity of the projectile at any selected instant during its flight.

Rifle.—A cannon or gun with the interior surface of its bore grooved with spiral channels or cuts, thus giving the projectile a rotary motion. If the interior surface of the bore is not rifled, the cannon is known as **smooth bore.**

Ricochet.—A glancing rebound of a projectile after impact.

Rifling.—Helical grooves cut in the surface of the bore for the purpose of giving a rotary motion to the projectile. The rib of metal between two adjacent grooves is called a *land.*

Rimbases.—The masses of metal uniting the trunnions of a cannon with the trunnion band.

Rotating Band.—The copper band encircling projectiles near their base for the purpose of giving them angular rotation in passing through the rifling of the bore.

Round.—The firing of a single load from each gun of a battery not simultaneously.

Roving Light.—A searchlight intended to search the battle area within the field not covered by fixed lights.

Safety Lanyard.—A safety device attached to seacoast cannon consisting of a lanyard wound on a drum working against the action of a spring and attached to the gun. It is so arranged, by means of a rachet and pawl, that a pull on the firing lanyard cannot be transmitted to the primer until the gun is in battery.

Salvo.—The simultaneous or successive firing of a single shot from each piece of a pit, platoon, battery or other tactical group of armament.

Salvo Interval.—The time interval between successive shots of a salvo.

Salvo Point.—A point, the azimuth and range of which are known and conspicuously posted in the battery; at which a concentrated fire from one or more batteries may be directed. Certain points in narrow channels are usually selected as salvo points.

Salvo Table.—A table giving ranges and azimuths of salvo points.

Secondary Armament.—The armament of the coast artillery ser-

vice assigned to attack unarmored and lightly armored vessels. It consists of guns from 10 to 3 inches in caliber.

Seating Distance.—The distance from the face of the breech to the base of the projectile when the latter is in position for firing.

Securing Pin.—(Guns). Short, steel pins, usually four in number, placed radially near the muzzle to prevent the C hoops from moving forward over the tube and the tube from rotating due to the reaction of the rifling on the projectile.

Service Charge.—The maximum quantity of powder that is prescribed to be used in any seacoast cannon.

Serving Table.—A table for keeping a supply of projectiles convenient to the breech during firing.

Set Forward Point.—A point on the course of a target at which it is predicted that the target will arrive at the end of the predicting interval plus the time of flight for the range.

Shell.—A projectile with a large cavity for explosive.

Shell Filler.—An explosive used to make up the bursting charge in a projectile.

Shell Room or Shot Room.—A room for the storage of projectiles.

Shell Tracer.—A device attached to the base of a projectile which enables its flight to be followed. In the day time a smoke (which is visible) is emitted and at night a bright flame.

Shot.—A projectile with a small cavity for explosive; also the firing of a single load from a single gun or mortar.

Shot Hoist.—A device for raising projectiles from the hoist room to the loading or truck platform. Sometimes called **ammunition hoist.**

Shot Tongs.—A device used in lifting projectiles.

Sight.—A device by which the gun pointer gives the gun the proper direction for firing. Sights are of two classes, open and telescopic.

Sight Standard.—The upright of the carriage which supports the sight.

Site.—See angle of site.

Sleeve.—A tube into which a rod or another tube is inserted. If serving merely to strengthen the object which it encloses, it is a reinforce.

Slope of Fall.—The tangent of the angle of fall.

Smooth Bore Cannon.—See **Rifle.**

Star Guage.—A device for measuring the diameter of the bore of cannon. It is used during the manufacture and when it is necessary to determine if any enlargement of the bore has taken place.

Striking Velocity.—The velocity of the projectile at the point of impact.

Subcaliber Tube.—A small gun which is fitted in the bore of a gun of larger caliber.

Superior Slope.—The top slope of a parapet or traverse.

Summit.—The point of maximum altitude on a trajectory.

Swell of the Muzzle.—The enlargement of the exterior of the cannon at the muzzle.

Targ.—The piece of metal (or other material) used to determine the intersection of the arms on the plotting board.

Tide Station.—A station at which periodical readings of height of tide are made, recorded and sent to the various stations.

Time of Flight.—The elapsed time from the instant the projectile leaves the bore to the instant that it reaches the point of impact. The values given in range tables are for the point of fall.

Time Interval Bell or T. I. Bell.—A bell to indicate the observing interval. Bells ring simultaneously at the emplacements and the observing stations. They are operated by a clock or a motor.

Time Range Board.—A board to show range of target from battery at any instant. It is emplaced on the emplacement wall and is operated on data from the plotting room.

Throttling Bar.—A bar in the recoil cylinder to regulate the size of the orifice through which the liquid escapes from one side of the piston head to the other.

Throttling Pipe.—A pipe connecting the rear ends of two recoil cylinders. The throttling and the equalizing pipes are joined by a connecting

pipe through which liquid flows from one end of the cylinders to the other without passing through the piston heads. The amount of liquid which passes through the connecting pipes is controlled by the throttling valve. The recoil of the gun can be controlled to a certain extent by varying the setting of the throttling valve.

Trajectory.—The curve of double curvature described by the center of gravity of a projectile in flight.

Travel of Projectile.—The distance from the base of the projectile in its seat to the face of the muzzle of the cannon.

Traverse.—The structure protecting the armament and personnel from flank fire. Also a term used to indicate the horizontal travel of the piece on its carriage either to the right or left.

Traversing Rollers.—Rollers which rest upon the base ring and which enable the gun or mortar carriage to be given motion right or left.

Tripping.—The act of releasing the counterweights of a disappearing carriage, and thus causing the piece to go into its firing position.

Truck Platform.—If the ammunition trucks run on a different surface from that of the loading platform, this surface is called the *truck platform.*

Truck Recess.—The spaces built in the parapet wall for the storage of ammunition trucks.

Trunnions.—The cylinders supporting the cannon and about which it revolves in elevating and depressing.

Trunnion Band.—The hoop of which the trunnions of a cannon form a part.

Trunnion Sight Bracket.—A bracket attached to the trunnion of a cannon, which may be used for holding the telescopic sights.

Tube.—The inner cylinder of a cannon.

Twist of the Rifling.—The inclination of the grooves to the axis of the cannon at any point. When this inclination is constant, the twist is uniform; when it increases from the breech to a point near the muzzle, the twist is increasing. Twist is generally expressed in turns per caliber, e.g., one turn in fifty calibers, meaning that if the twist were uniform the projectile would make one complete rotation in passing over a distance equal to fifty calibers.

Vent.—A small channel leading from the exterior of the cannon to the powder chamber for the ignition of the powder charge. It is an **axial vent** when it is in line with the axis of the bore. It is a **radial vent** when it is at right angles to the axis of the bore.

Yaw.—The angle between the tangent to the trajectory and the longitudinal axis of the projectile.

Y-Azimuth.—A horizontal angle measured in a clockwise direction from the north point of the Y-Line through the observer.

Y-Line.—The origin line for the measurement of Y-azimuth. The north and south line of the Grid projection being used.

Zone.—In mortar firing, the area in which projectiles fall for a given charge of powder, when the elevation is varied between the minimum and maximum.

It is also used with reference to other divisions of the defensive area, as **outer defense zone, inner defense zone,** etc.

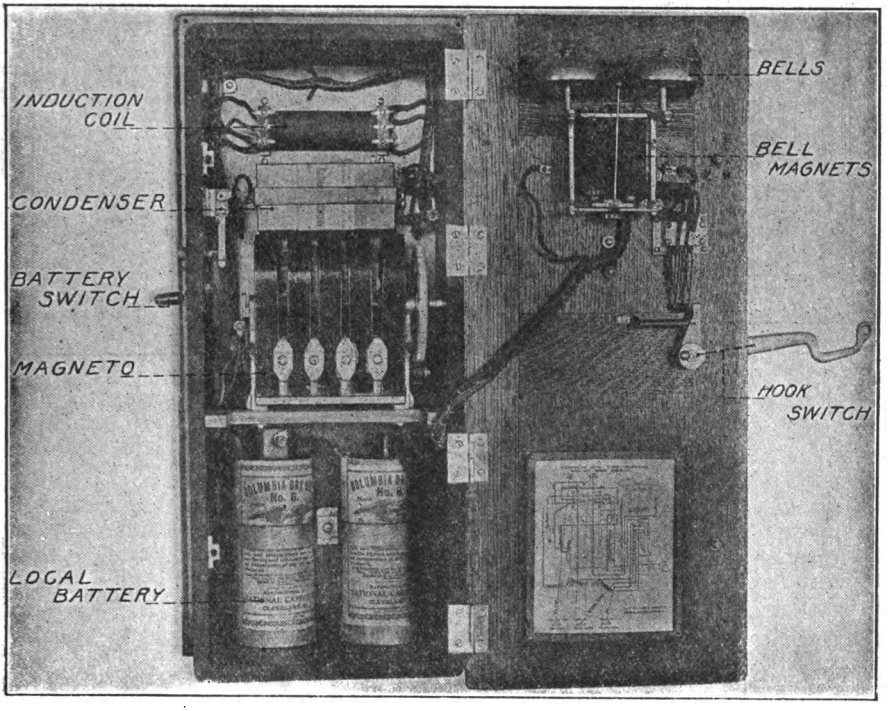
APPENDIX "C"

THE TELEPHONE*

THE INSTRUMENT

Q. What is the telephone?

A. A telephone is an instrument by means of which a sound produced at one end of a wire is reproduced at the other end.



COMPOSITE ARTILLERY TYPE TELEPHONE

Q. What two types of telephones are used in the Coast Artillery service?

A. The "composite artillery type" and the "common-battery artillery type."

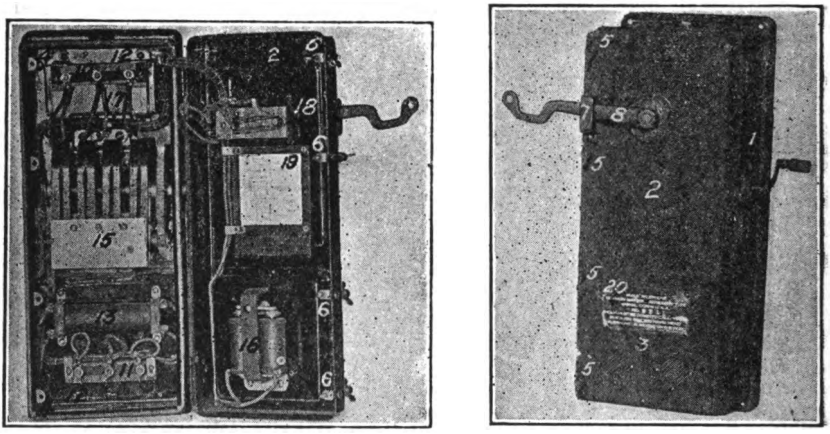
Q. What is the chief difference between the two types?

A. In the composite type use may be made of either a common or a local battery; while in the common-battery type only a common battery is used.

* This information about the telephone is not now required in the gunners' examination, but it is thought that it is sufficiently valuable to the enlisted man to warrant its insertion as an Appendix.

Q. What are the two classes of telephone "sets" in artillery work, and how are they used?

A. "Auxiliary sets" and "talking sets," so arranged that any of the talking sets can be used with any auxiliary set to make up a complete telephone. The auxiliary set contains all the local parts of the telephone proper, except the receiver and transmitter. The talking sets are the receiver and transmitter made up in different forms for different kinds of service.



COMMON-BATTERY ARTILLERY TYPE TELEPHONE

1. METAL CASE, COMPLETE.
2. METAL CASE, DOOR FOR.
3. METAL CASE, METAL PLATE FOR PROTECTING GONGS OF RINGER, COMPLETE.
4. SCREW FASTENER, INTERNALLY THREADED.
5. WING BOLT FOR FASTENING DOOR.
6. ANGLE PIECE FOR SUPPORTING WING BOLT.
7. HOOK, STOP.
8. HOOK, COMPLETE.
9. HOOK RETAINER.
10. HARD-RUBBER STRIP WITH 3 WING-NUT BINDING POSTS, LINE.
11. HARD-RUBBER STRIP WITH 3 WING-NUT BINDING POSTS, TALKING SET.
12. WING-NUT BINDING POST, COMPLETE.
13. INDUCTION COIL.
14. INDUCTION COIL, TERMINALS FOR.
15. GENERATOR.
16. RINGER.
17. CONDENSER.
18. SWITCH, HOOK, COMPLETE.
19. PLATE, CIRCUITS.
20. NAME PLATE, DIRECTION.

Q. Name the different auxiliary sets.

A. Of the composite type: wall set; *plotter's set;* battery commander's set; portable set; and gun set.

Of the common-battery type: wall set; battery commander's set; portable set; and gun set.

Q. Name the different talking sets.

A. The head set, hand set, and desk set.

Q. What supplies the energy to operate the telephone?

A. Composite type: a central storage battery located in the switchboard room; or a local battery of two dry cells located inside the telephone.

Common-battery type: a central storage battery located in the switchboard room.

Q. What other telephones obtain current from the same central storage battery?

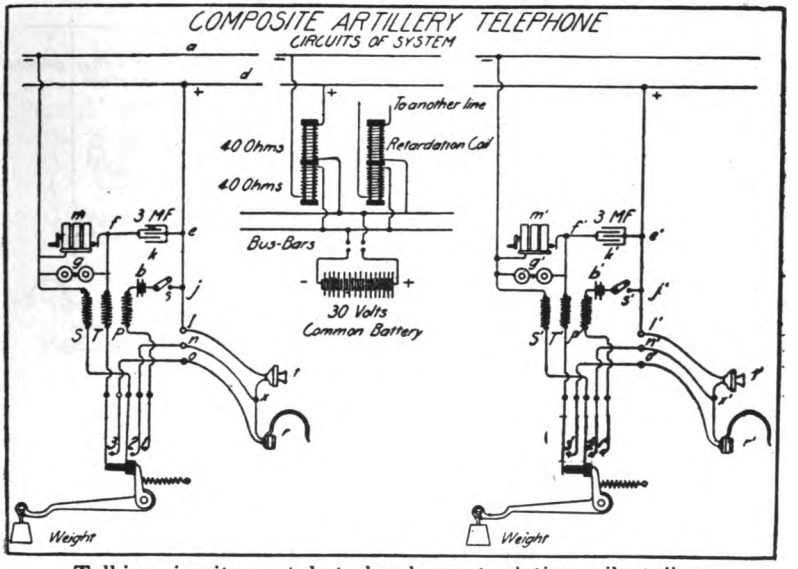
A. All the other telephones in the same fort command.

Q. What is the voltage across the terminals of the central storage battery?

A. 30 volts.

Q. Are these dry cells in the telephone now?

A. No; they are furnished only in time of war for use when the central storage battery fails.



Talking circuit: + bat., bus bar, retardation coil, + line, + binding post, e, j, l, t, x, n, contact 2, S, − line, retardation coil, bus bar, − bat.

Hearing circuit: T, f, k, e { j, l, t, - - - - - - - - - - + line. e′ { k′, f′, T′, 3′, o′, r′ / j′, l′, t′ - - - - - } - - - - - - - - - x′, n′, 2′, S′, − line, S, 2, n, } x, r, o, 3, T.

Ringing circuit: m, f { g - - - - - - - - - - - - k, e, + line, e′, k′, f′, g′, − line, m }

Q. Point out the battery switch (*of the composite type only*).

Q. What is its use?

A. It makes and breaks the local battery circuit.

Q. Upon which post should it be left?

A. Upon the post marked "Common Battery."

Q. How many circuits are there in this telephone?

A. Three: the primary, or talking circuit; the secondary, or hearing circuit; and the ringing circuit.

Q. Trace the primary circuit.

Q. What part does this circuit pass through?

A. The transmitter, the induction coil, the retardation coil, and the hook switch.

Q. Point out the transmitter.

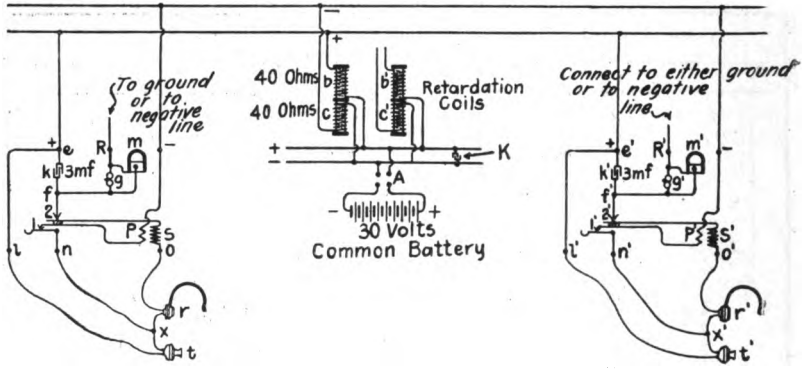
Q. What is its function?

A. The transmitter causes the strength of the current in the primary circuit to fluctuate whenever sound waves fall upon its diaphragm.

Q. Point out the induction coil.

Q. What is its function?

A. The induction coil induces an alternating current in the hearing circuit in unison with the fluctuations in the talking circuit current.



COMMON BATTERY TELEPHONE CIRCUITS OF SYSTEM

Talking circuit:

+ bat., + bus bar, retardation coil b, + line, + binding post, e, l, t, x, n, hook switch contact 1, P, − binding post, − line, retardation coil c, − bus bar, − bat.

Hearing circuit:

Distant

S, hook switch contact 2, f, k, e, + line, e′, k′, f′, hook switch contact 2′, S′, o′, r′, x′, n′, hook switch contact 1′, P′, − binding post, − line, − binding post, P, hook switch contact 1, n, x, r, o.

Local

S, hook switch contact 2, f, k, e, l, t, x, r, o.

Ringing circuit:

Distant

Magneto m, R, through ground or negative line R′, g′, f′, k′, e′, + line, e, k, f, m.

Local

Magneto m, through g to magneto.

Q. Point out the retardation coil.

Q. What is its use?

A. It prevents the talking or ringing on one line from being heard on the other lines in the fire command.

Q. Point out the hook switch.

Q. What is its use?

A. It breaks the local circuit when the receiver is up, thus preventing the storage battery from running down. It also breaks the secondary circuit and allows the bells to be rung.

Q. Point out the line terminal posts.

Q. Trace the local branch of the hearing circuit.

Q. Trace the line branch of the hearing circuit.

Q. What parts are in the hearing circuit?

A. The receiver, the induction coil, the condenser, the transmitter and the hook-switch of both the local and distant phones.

Q. Point out the receiver.

Q. What is its use?

A. The object of the receiver is to reproduce sound waves when its coils are energized by the alternating current in the hearing circuit.

Q. Point out the condenser.

Q. What is its function?

A. It prevents the direct current from the storage battery from flowing through the bell and the generator. It also makes the talking more distinct.

Q. Trace the ringing circuit.

Q. What parts are in the ringing circuit?

A. The generator, the bell, and the condenser.

Q. Point out the generator.

Q. What is its function?

A. By turning the generator crank, the armature is revolved and an alternating current is generated which rings the bells.

Q. Point out the bell.

Q. What are its functions?

A. It rings to notify the operator that he is wanted.

Q. Point out the terminal posts for the head set.

Q. How can you tell which wire should be attached to each post?

A. The wires are of different colors and the terminal posts are labeled with the corresponding colors.

Q. What different kinds of composite artillery type telephones are there?

A. The wall telephone, the plotter's telephone, the gun telephone, the battery commander's telephone, the desk telephone, and the portable telephone.

Q. Tell how to open station.

A. (a) Take the head set or retaining spring off the hook and put on the head set.

(b) See that the connections are tight. These include the two connections to the line and three for the head set.

(c) Lower and raise the hook. A sharp click should be heard. A slight scratching in the transmitter should be heard in the receiver.

(d) Call the name of the distant station.

(e) To ring up the distant station, hold the hook down and turn the generator handle. Release the handle to converse. If any hooks on the line are up, none of the distant bells will ring.

Q. How is the station closed?

A. Call ', close station" to distant station; hang receiver on hook or attach retaining spring; wipe off both receiver and transmitter.

Q. What care should be taken of the telephone?

A. Never leave the station with the hook up; keep the nuts on the terminal posts tight and the cords clear of tangles; polish up the outside nickel work once a week; keep the door shut; report trouble in the talking to the station chief.

APPENDIX "D"

List of Ordnance Pamphlets for Reference

(Where more than one number is given in one item, the numbers and subjects are in corresponding sequence.)

Nos.	Subjects.
1872	Ammunition, seacoast artillery.
1656 1657	Azimuth instruments, W. & S.: 1910; 1900, and 1900 MI
1665	Breech mechanism.
1666 1668	Board, deflection: gun, 1905; mortar.
1669 1672	Board, plotting: gun and mortar; 360°, mod. 1911, mortar
1663 1674	Board, range, gun: Pratt; 1909.
1676	Cannon and projectiles, table, U. S. Army.
1701	Carriage, 15-pdr., barb., 1903.
1683 1684	Carriages, 5-inch: balanced pillar, 1896; barb., 1903.
1686- 1688 1703 1704	Carriages, 6-inch: disap., L. F., 1898; disap., L. F., 1903; barb., 1901; disap., L. F., 1905; disap., L. F., 1905 MI.
1685 1689 1690	Carriages, 8-inch: barb., 1892; disap., L. F., 1894; disap., L. F., 1896.
1691- 1694 1700	Carriages, 10-inch: disap., L. F., 1894; disap., L. F., 1896; disap., A. R. F., 1896; disap., 1901; barb., 1893.
1695- 1697 1702	Carriages, 12-inch: disap., L. F., 1896; disap., L. F., 1897; disap., L. F., 1901; barb., 1892.
1712	Carriage, 14-inch, disap., L. F., 1907 and 1907 MI.
1698 1699 1705 1707 1709	Carriages, 12-inch mortar: 1891; 1896; 1896 MI; MII 1908; 1896 MIII.
1706 1708 1710	Carriages, *Dummy:* 12-inch mortar, 1912; 15-pdr., 1912; 10-inch disap., L. F., 1912.
1727	Fuses.
1763	Gun, 6-pdr., and mount.

1768 Gun, 3-inch saluting and mount.
1756, 1766, 1772 Guns, 15-pdr.: 1898; 1902; 1903.
1749-1751 Guns, Armstrong, 4.72-inch: 40-cal.; 45-cal.; 50-cal.
1765 Guns, 5 and 6-inch.
1752 Gun, Armstrong, 6-inch.
1803 Hydraulic jacks.
1794 Indicator, wind component.
1795 Instruments for fire control system: care, preservation, etc.
1721 Loading projectiles with explosive D.
1869 Materials for cleaning, preservation, etc.
1820 Mortars, 12-inch.
1868 Paints for projectiles.
1873-1876 Position finders, depression: Lewis, 1898; Rafferty, B; Swasey; Lewis, 1907.
1946 Prediction scale, etc.
1738 Pressure gauge outfits.
1881 Primers.
1905 Range-finder, Barr and Stroud, 9-ft., horizontal, self-contained.
1952, 1955, 1956, 1958 Sights: for cannon; 3-inch telescopic; 2-inch tel., 1906; 2-inch 1906; 2-inch tel., 1909.
1888 Smokeless powder, etc., care of.
1986 Subcaliber guns.
1991 Targets.
2000 Telescope, observation, 1908.

APPENDIX "F"

COAST ARTILLERY
MEMORANDUM NO. 10.

WAR DEPARTMENT,
WASHINGTON, *November 25, 1910.*

The following abridged instructions for loading projectiles with Explosive D for use in instruction of gunners as contemplated in paragraphs 984 to 996, inclusive, Coast Artillery Drill Regulations, 1909, are published for the information and guidance of all concerned.

1. The service high explosive for bursting charges of projectiles for seacoast cannon is known as Explosive D. It is very insensitive to shock and, so far as known, can not be exploded by any means incident to handling or transportation. It has been adopted as a bursting charge in steel shell and shot of calibers from the 2.95-inch to 14-inch, inclusive. In projectiles smaller in caliber than 2.95-inch a different explosive is used as a bursting charge.

2. Explosive D is far more powerful and very much less sensitive than black powder. Its insensitiveness is illustrated by the fact that it is not exploded by impact of the projectile in which inserted against the hardest steel plate unless a detonating fuze is used in the shell.

3. Explosive D can be inserted in projectiles under pressure either by a hydraulic press or by hand with suitable ramming tools. The latter method having been found practicable, and not necessitating the installation of an expensive apparatus, has been adopted. The explosive used in projectiles under 2.95-inch caliber is compressed in the projectiles by means of a hydraulic press.

4. For convenience of reference projectiles are divided into three classes —minor, medium, and major caliber. Minor caliber projectiles comprise all projectiles from the 1-pounder to the 2.38-inch, inclusive; medium caliber projectiles comprise all from the 2.95-inch to the 7-inch, inclusive, and major caliber projectiles comprise all from the 8-inch to the 16-inch, inclusive.

5. To facilitate manufacture, all steel projectiles from the 5-inch to the 16-inch, inclusive, consist of two parts, the body of the projectile and the base plug, which is threaded to screw into a correspondingly threaded seat in the body. The base plug is provided with a fuze hole suitably tapped and counterbored for the fuze.

6. Projectiles under 5-inch in caliber, except a limited number of earlier manufacture, are not provided with base plugs, the fuze alone serving to close the cavity.

7. All steel projectiles using a bursting charge of high explosive are arranged to take a base detonating fuze with the exception of a limited number of 2.95-inch mountain gun and 3-inch field gun shell, which are arranged for a point detonating fuze. All projectiles below 4.7-inch caliber will be loaded and fuzed prior to issue.

8. Projectiles loaded with Explosive D require a detonating fuze to develop the force of explosion; the ordinary percussion fuze used to ignite black powder bursting charges has not sufficient power.

9. To eliminate the danger of premature bursts, due to the powder gases of the propelling charge passing the threads of the fuze and base plug and entering the cavity of the projectile, a copper base cover is crimped into an undercut groove in the base of the projectile after the detonating fuze has been inserted.

10. Explosive D is issued in barrels containing 125 pounds of explosive, net. It should be stored in dry magazines or such other buildings as may be available for the purpose.

11. The room selected for loading projectiles with Explosive D must be cleared of all other stores and thoroughly cleaned for the purpose (*especial care being taken to keep the explosive free from lime, dirt, or other foreign material*). Dust particles of the explosive must be cleared up at the end of each day's work, and the whole room must be carefully washed out after completing the filling of the projectiles on hand or when the use of the room is to be resumed for other purposes.

12. No metallic or other paints, except those especially provided by the Ordnance Department for the purpose, will be used in connection with the loading, especially for the interior of projectiles. Lead paints are particularly objectionable, as they are liable to act upon the explosive and form compounds very sensitive to shock.

13. No fire will be allowed in the room or in proximity thereto, and no matches will be allowed in the room. In other words, every precaution will be observed to guard against the possibility of accident.

14. Detonating fuzes will be handled carefully; dropping them on hard surfaces or marring or jamming them should be avoided.

15. Disassembling detonating fuses at posts for any purpose whatever *is prohibited.* This prohibition is made especially to guard against the probability of accident on account of the sensitiveness of the fuzes.

16. As a rule, the fuze should be assembled in the projectile, and the base cover attached, on the day on which they are filled.

17. The projectiles prepared for service will be stored in a dry place, which must be fireproof and remote from danger of fire. The burning of a building in which these projectiles are stored would constitute a source of danger that must be avoided.

18. For unfuzed projectiles already issued to posts, the fuzes and base covers are held by the ordnance officers at the posts.

19. In loading projectiles with Explosive D their cavities are first carefully cleaned and then coated with ruberine or other authorized paint. When this has set the projectile is charged, the explosive being added in small quantities and rammed solid. The fuze seat is formed in the solid mass with suitable tools, after which the fuze is inserted and the base cover added and calked in place.

20. Projectiles charged with Explosive D, fuzed or unfuzed, have the whole surface in rear of the rotating band painted a deep yellow color.*

BY ORDER OF THE SECRETARY OF WAR:

LEONARD WOOD,
Major General, Chief of Staff.

OFFICIAL:
HENRY P. McCAIN,
Adjutant General.

*This has been modified in more recent orders.—Editor.

APPENDIX "G"

U. S. MAGAZINE RIFLE

DESCRIPTION OF THE OPERATION OF THE PRINCIPAL PARTS

Most of the operating parts may be included under the *bolt mechanism* and *magazine mechanism.*

The bolt moves backward and forward and rotates in the well of the receiver; it carries a cartridge, either from the magazine or one placed by hand in front of it, into the chamber and supports its head when fired.

The hook of the extractor engages in the groove of the cartridge case and retains the head of the latter in the countersink of the bolt until the case is ejected.

The safety lock when turned to the left, is inoperative; when turned to the right—*which can only be done when the piece is cocked*—the point of the spindle enters its notch in the bolt and locks the bolt; at the same time its cam forces the cocking piece slightly to the rear, out of contact with the sear, and locks the firing pin.

The bolt mechanism operates as follows: To open the bolt, raise the handle until it comes in contact with the left side of the receiver and pull directly to the rear until the top locking lug strikes the cut off.

To close the bolt, push the handle forward until the extracting cam on the bolt bears on the extracting cam on the receiver, thereby unlocking the sleeve from the bolt, and turn the handle down. As the handle is turned down, the cams of the locking lugs bear against the locking shoulders in the receiver, and the bolt is forced slightly forward into its closed position. The piece is then ready to fire.

To pull the trigger, the finger piece must be drawn to the rear until contact with the receiver is transferred from its bearing to the heel, which gives a creep to the trigger, and then until the sear nose is withdrawn from in front of the cocking piece.

Double loading from the magazine is prevented by the extractor engaging the cartridge case as soon as it rises from the magazine and holding its head against the face of the bolt until ejected.

The piece may be cocked either by raising the bolt handle until it strikes the left side of the receiver and then immediately turning it down, or by pulling the cocking piece directly to the rear.

The opening and closing of the bolt should each be done by one continuous motion.

To charge the magazine, see that the cut-off is turned up showing *on*, draw the bolt fully to the rear, insert the cartridges from a clip, or from the hand, and close the bolt. To charge the magazine from a clip, place either end of a loaded clip in its seat in the receiver and, with the thumb of the right hand, press the cartridges down into the magazine until the top cartridge is caught by the right edge of the receiver. The magazine can be filled, if partially filled, by inserting cartridges one by one.

Pushing the bolt forward, after charging the magazine, ejects the clip.

When the cut-off is turned down, the magazine is *off*. The bolt cannot be drawn fully back, and its front end projecting over the rear end of the upper cartridge holds it down in the magazine below the action of the bolt. The magazine mechanism then remains inoperative, and the arm can be used as a single-loader, the cartridges in the magazine being held in reserve. The arm can readily be used as a single-loader with the magazine empty.

When the cut-off is turned up, the magazine is *on*; the bolt can be drawn fully to the rear, permitting the top cartridge to rise high enough to be caught by the bolt in its forward movement. As the bolt is closed, this cartridge is pushed forward into the chamber, being held up during its passage by the pressure of those below. The last one in the magazine is held up by the follower, the rib on which directs it into the chamber.

In magazine fire, after the last cartridge has been fired and the bolt drawn fully to the rear, the follower rises and holds the bolt open to show that the magazine is empty. .

Precautions

If it is desired to carry the piece cocked, with a cartridge in the chamber, the bolt mechanism should be secured by turning the safety lock to the right.

Under no circumstances should the firing pin be let down by hand on a cartridge in the chamber.

To obtain positive ejection, and to insure the bolt catching the top cartridge in magazine, when loading from the magazine, the bolt must be drawn fully to the rear in opening it.

When the bolt is closed, or slightly forward, the cut-off may be turned up or down, as desired. When the bolt is in its rearmost position, to pass from loading from the magazine to single loading, it is necessary to force the top cartridge or follower below the reach of the bolt, to push the bolt slightly forward and to turn the cut-off down, showing *off*.

In case of a misfire, it is unsafe to draw back the bolt immediately, as it may be a case of hang-fire. In such cases the piece should be cocked by drawing back the cocking piece.

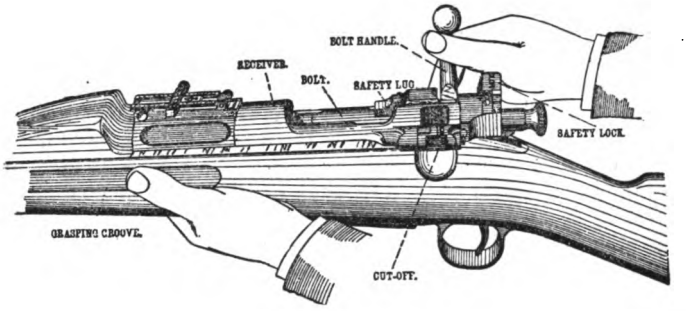
It is essential for the proper working and preservation of all cams that they be kept lubricated.

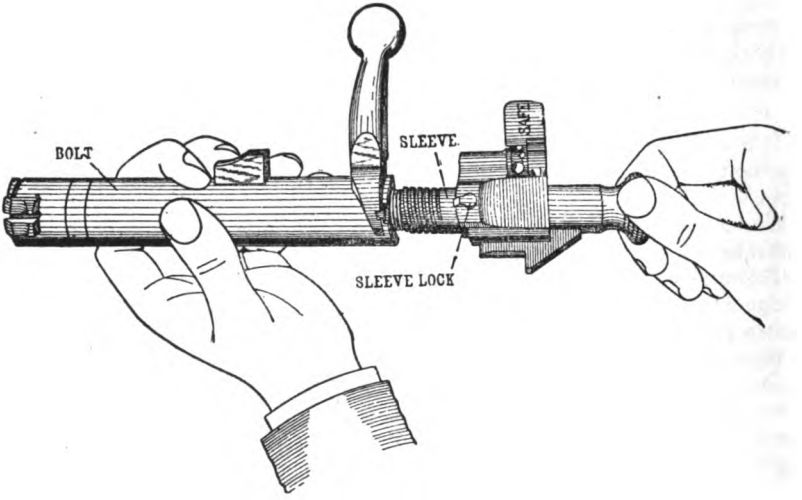
DISMOUNTING AND ASSEMBLING BY SOLDIER

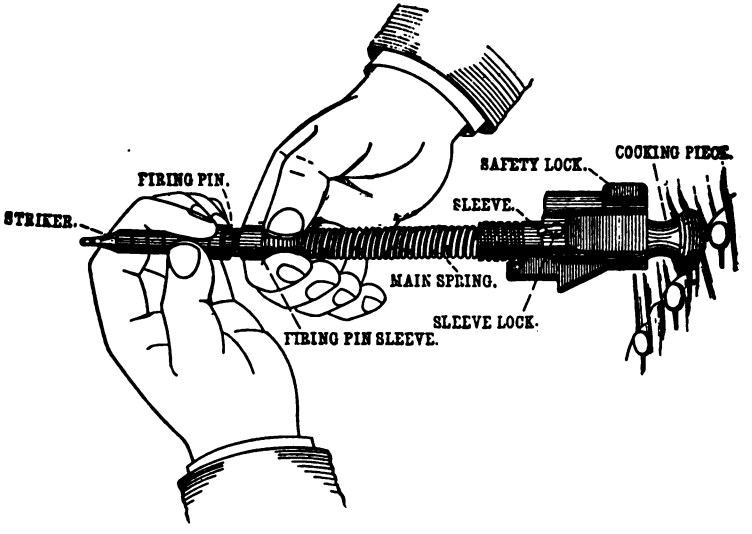
The bolt and magazine mechanism can be dismounted without removing the stock. The latter should never be done, except for making repairs, and then only by some selected and instructed man.

To Dismount Bolt Mechanism

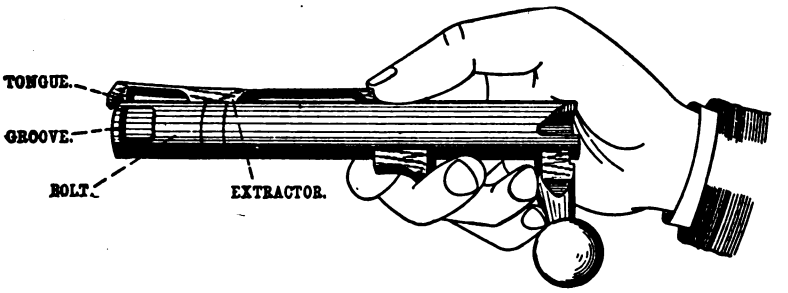
Place the cut-off at the center notch; cock the arm and turn the safety lock to a vertical position, raise the bolt handle and draw out the bolt. Hold bolt in left hand, press sleeve lock in with thumb of right hand to unlock sleeve from bolt, and unscrew sleeve by turning to the left. Hold sleeve between forefinger and thumb of the left hand, draw cocking piece back with middle finger and thumb of right hand, turn safety lock down to the left with forefinger of the right hand, in order to allow the cocking piece to move forward in sleeve, thus partially relieving the tension of mainspring; with the cocking piece against the breast, draw back the firing pin sleeve with





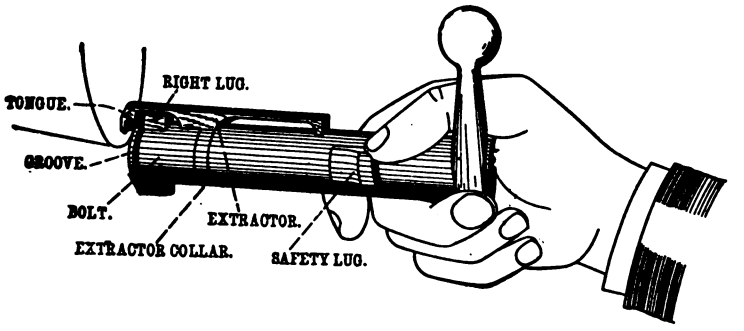


forefinger and thumb of right hand and hold it in this position while removing the striker with the left hand; remove firing pin sleeve and mainspring; pull firing pin out of sleeve; turn the extractor to the right, forcing its tongue out of its groove in the front of the bolt, and force the extractor forward and off the bolt.



To Assemble Bolt Mechanism

Grasp with the left hand the rear of the bolt, handle up, and turn the extractor collar with the thumb and forefinger of the right hand until its lug is on a line with the safety lug on the bolt; take the extractor in the right hand and insert the lug on the collar in the undercuts in the extractor by pushing the extractor to the rear until its tongue comes in contact with the rim on the face of the bolt (a slight pressure with the left thumb on the top of the rear part of the extractor assists in this operation); turn the extractor to the right until it is over the right lug; take the bolt in the right hand and



press the hook of the extractor against the butt plate, or some rigid object, until the tongue on the extractor enters its groove in the bolt. With the safety lock turned down to the left to permit the firing pin to enter the sleeve as far as possible, assemble the sleeve and firing pin; place the cocking piece against the breast and put on mainspring, firing pin sleeve, and striker. Hold the cocking piece between the thumb and forefinger of the left hand, and by pressing the striker point against some substance, not hard enough to injure it, force the cocking piece back until the safety lock can be turned to the vertical position with the right hand; insert the firing pin in the bolt and screw up the sleeve (by turning it to the right) until the sleeve lock enters its notch on the bolt. See that the cut-off is at the center notch; hold the piece

under floor plate in the fingers of the left hand, thumb extending over the left side of the receiver; take bolt in right hand with safety lock in a vertical position and safety lug up; press rear end of follower down with left thumb and push bolt into the receiver; lower bolt handle; turn safety lock and cut-off down to the left with right hand.

To Dismount Magazine Mechanism

With the bullet end of a cartridge press on the floor plate catch (through the hole in the floor plate), at the same time drawing the bullet to the rear; this releases the floor plate. Raise the rear end of the first limb of the magazine spring high enough to clear the lug on the floor plate and draw it out of its mortise; proceed in the same manner to remove the follower.

To assemble magazine spring and follower to floor plate, reverse operation of dismounting.

Insert the follower and magazine spring in the magazine, place the tenon on the front end of the floor plate in its recess in the magazine, then place the lug on the rear end of the floor plate in its slot in the guard, and press the rear end of the floor plate forward and inward at the same time, forcing the floor plate into its seat in the guard.

CLEANING AND CARE OF THE ARM

As the bore of the rifle is manufactured with great care in order that a high degree of accuracy may be obtained, it should be carefully cared for. The residuum from smokeless powder tends to corrode the bore and should therefore be removed as soon after firing as practicable. The following method has been practiced at the Springfield Armory for a number of years with good results: Using the cleaning rod and small patches of cloth (preferably canton flannel), clean the bore thoroughly with patches soaked in saturated solution of soda and water. Then thoroughly dry the bore and remove the soda solution by the use of dry patches, and finally oil the bore with patches soaked in cosmic oil. Twenty-four hours after this first cleaning, the bore should be again cleaned as described above, as it has been found that the powder gases are probably forced into the texture of the steel and will, if the second cleaning is not resorted to, cause rusting, no matter how thoroughly the bore may have been cleaned at first.

If, however, a cleaning rod is not at hand, the barrel should be cleaned as thoroughly as possible by means of the thong brush and rags, and oiled as above. To clean or oil the bore with rags, the thong brush is unscrewed, the rag placed in the rag slot of the thong tip and drawn from the muzzle toward the breech.

If gas escapes at the base of the cartridge, it will probably enter the well of the bolt through the striker hole. In this case the bolt mechanism must be dismounted and the parts and well of the bolt thoroughly cleaned.

Before assembling the bolt mechanism, the firing pin, the barrel of the sleeve, the body of the striker, the well bolt, and all cams should be lightly oiled.

Many of the parts can generally be cleaned with dry rags. All parts after cleaning should be wiped with an oil rag. The best method of applying oil is to rub with a piece of cotton cloth upon which a few drops of oil have been placed, thereby avoiding the use of an unnecessary amount of oil; this method will, even in the absence of the oiler, serve for the cams

and bearings, which should be kept continually oiled. Any part that may appear to move hard can generally be freed by the use of a little oil.

The stock and hand guard may be coated with raw linseed oil and polished by rubbing with the hand.

Sperm oil only should be used for lubricating metallic bearing and contact surfaces.

For the chamber and bore, only cosmoline or cosmic should be used. This should also be applied to all metallic surfaces, to prevent rusting when arms are stored or when not used for an appreciable length of time.

INSTRUCTIONS FOR CLEANING FROM "SMALL ARMS FIRING MANUAL" (PAR. 134)

After firing, the bore of the rifle is covered with fouling. This is of two kinds, a black deposit covering the entire bore, caused by the burning powder and easily removed with rags, and a metallic fouling, caused by particles of the metal jacket of the bullet adhering to the barrel, which can be removed only by the use of ammonia solution.

The powder fouling must be removed first. Then the metallic fouling can be seen in patches on the lands.

To remove the powder fouling use a cleaning rod long enough to clean from the breech; Hoppe's Powder Solvent No. 9; rags, about 1¼ inches square, of thin flannel or any other soft material.

A cleaning rack should be provided for every barrack.

Rifles should always be cleaned from the breech, thus avoiding any possible injury to the muzzle. Any injury to the rifling at the muzzle will affect the shooting adversely. If the bore for a length of 6 inches at the muzzle is perfect, a minor injury near the chamber will have little effect on the accuracy of the rifle.

The rifle should be cleaned as soon as the firing for the day is completed. The fouling is easier to remove then, and if left longer it will corrode the barrel.

Take a couple of rags soaked in No. 9 and run them through the barrel until they have removed all the powder fouling; run clean rags through to dry the barrel; clean with ammonia solution as directed and finish by wiping out with a greased rag or a clean rag soaked in No. 9. For grease, use vaseline, cosmic, or "3 in 1" oil. After the barrel is cleaned, wipe out the chamber, the cams, bolt, and all visible working parts. Occasionally clean out the magazine and wipe off magazine spring, then wipe all working parts with a greased rag.

After cleaning the working parts, wipe off stock and outside of barrel with oiled rag.

Before firing again, wipe all oil out of barrel, but leave chamber and working parts slightly oily. This will prevent shells binding in chamber and will make parts work easier. Wipe all oil from outside of barrel and stock.

To remove metallic fouling, use ammonia solution. This is made as follows: Take ammonia persulphate, 1 ounce; ammonium carbonate, 200 grains; ammonia (28 per cent), 6 ounces; water, 4 ounces. One rounded tablespoonful equals 1 ounce of persulphate or 200 grains of carbonate.

Powder the persulphate and carbonate separately. Dissolve the persulphate in the ammonia and the carbonate in the water and then pour the mixture in a strong bottle, and cork. If mixed in this manner, it may be used in an hour.

To use.—After the barrel has been cleaned with No. 9 and wiped dry, cork up breech with a small cork, put a piece of rubber tubeing about an inch long on the muzzle, and fill the barrel with the solution. It will boil up instantly with a white foam, very slightly blue. Let the solution stay in the barrel not more than 10 minutes and then pour out. If there was any metal fouling, the solution will be dark blue.

Fill the barrel with water to remove any remaining ammonia, pour out, and then remove the cork and rubber tube, wipe barrel perfectly dry, and then rub with oiled rag.

Care should be used in mixing and using this solution, for if improperly mixed or used it will injure the rifle. If the solution, after being used, is brown, it is bad and should be thrown away. The proportions of persulphate and carbonate should be the same in bulk. Too much persulphate will injure the barrel.

Keep the barrel filled. If the solution evaporates, it will leave a deposit of persulphate on the surface of the bore and will injure it.

An experienced noncommissioned officer should mix the solution and supervise its use.

Care should be taken not to spill the solution on the barrel or in the mechanism.

APPENDAGES AND ACCESSORIES

The oiler and thong case are carried in the butt of the stock. In one section is carried a small supply of sperm oil, and in the other the thong and brush used for cleaning the bore of the rifle.

The cap on the oil section is fitted with a wire, flattened at its point, which reaches to the bottom of the section and is used for applying oil, a drop or more at a time. *The oil is only for the lubrication of the working parts.* The cap is also provided with a leather washer to prevent leakage. The cap on the thong section has a leather pad on its outer surface, which prevents the noise that would result from the oiler striking the butt plate cap. The oiler should always be inserted in the stock so that the leather-tipped cap will be next to the butt plate cap.

The cleaning rod is made of brass rod 0.25 inch in diameter, and of sufficient length to extend through the barrel.

The front sight cover is made of sheet steel and pressed into shape. It is then case-hardened, giving it sufficient spring to cause it to hug closely the barrel and front sight stud, thereby retaining its position on the barrel. It is used to protect the sight and should be kept in place at all times. During firing, it may be removed, if desired.

The screwdriver has a large blade, a small blade, a spur, a pin, and a rivet. The large blade should be used for the large butt plate screw, the butt plate spring screw, and the guard screws; the small blade for all other screws, except the cut-off screw, for which the spur should be used. The pin serves as a drift in removing the butt plate cap, ejector, floor plate catch, sear and trigger pins, and the lower band spring. No other screwdriver should be used in the repair of the rifle.

AMMUNITION FOR U. S. MAGAZINE RIFLE, MODEL OF 1903

Ball cartridge.—The caliber .30 ball cartridge consists of the case, primer, charge of smokeless powder, and bullet. The case is of cartridge brass. The head of the case is grooved to provide for extraction of cartridge from

the chamber of the rifle. The initials of the place of manufacture, the number of the month, and the year of its fabrication are stamped on the head of case.

The primer consists of the cup, percussion composition, disk of shellacked paper, and anvil. The charge is of composition very similar to the powders used as propelling charges in field and seacoast guns. The normal charge weighs from 47 to 50 grains, varying with the lot of powder used. The bullet has a core of lead and tin composition inclosed in a jacket of cupro-nickel. It weighs 150 grains, and the point is much sharper and offers less resistance to the air than that of any previous model in the United States service. The standard muzzle velocity of this ammunition in the rifle is 2700 feet per second. The cartridge complete weighs about 395.5 grains, its weight varying slightly with variations in the weight of the powder charge. Five cartridges are packed in a clip. The clip body can be used a number of times, but the springs only once.

The gallery practice and dummy clip is provided with a strong bronze spring without tongues. Sixty ball cartridges in twelve clips are packed in a bandoleer. The bandoleer is made of olive drab cloth and contains six pockets, each holding two clips. The clips can be readily taken out by forcing back the fold of the pocket. The bandoleer is provided with a shoulder strap of olive drab webbing by which it is carried over the shoulder, and a safety pin is provided to afford an adjustment of its length to suit the convenience of the soldier. The bandoleer, with cartridges, weighs about 3.88 pounds.

Blank cartridge.—The *blank* cartridge, model of 1906, differs from the *ball* cartridge in the charge of powder and in the bullet, and in the fact that the case is tinned. The bullet is of paper, hollow, and contains a charge of smokeless powder, which insures the breaking up of the bullet on leaving the bore. A coating of paraffin on the outside of the bullet prevents the absorption of moisture by the paper. Model 1909 has no paper bullet.

Dummy cartridge.—The case of the dummy cartridge is tinned and provided with six longitudinal corrugations, also three circular holes in the corrugated portion. The tinning, corrugations, and holes afford unmistakable means for distinguishing the dummy from the ball cartridge, both by sight and touch. The bullet is the same as in the ball cartridge. The dummy primer has cup and anvil, but no percussion composition.

Guard cartridge.—This cartridge differs from the ball cartridge in the charge of powder and in the fact that second-class bullets having slight imperfections are used. Five grooves encircle the body of the case about the middle (old style), or six short straight grooves encircle it at the shoulder (new style), affording means for distinguishing it from the ball cartridge by either sight or touch. The charge gives a muzzle velocity of 1200 feet per second. This cartridge gives good results at 100 yards and has sufficient accuracy for use at 150 and 200 yards. The range of 100 yards requires a sight elevation of 450 yards, and ranges of 200 and 300 yards require elevations of 650 and 850 yards, respectively.

PARAGRAPH 292, ARMY REGULATIONS, 1913

"Enlisted men will not take their arms apart, except by permission of a commissioned officer under proper supervision, and only in the manner prescribed in the descriptive pamphlet of the arm issued by the Ordnance Department. The polishing of blued or browned parts of small arms, rebluing or rebrowning, putting any portion of an arm in a fire, or removing a receiver

from a barrel, is prohibited. The mutilation of any part by filing or otherwise, and attempts to beautify or change the finish, are prohibited. Pieces will be unloaded before being taken to quarters or tents, and as soon as the men using them are relieved from duty, unless otherwise ordered. The use of tompions in small arms is forbidden. The prohibition in this paragraph of attempts to beautify or change the finish of arms in the hands of enlisted men is not construed as forbidding the application of raw linseed oil to the wood parts of the arms. This oil is considered necessary for the preservation of the wood, and it may be used for such polishing as can be given by rubbing in one or more coats when necessary. The use of raw linseed oil only will be allowed for re-dressing, and the application for such purpose of any kind of wax or varnish, including heelball, is strictly prohibited."

APPENDIX "H"

(a) SERVICE OF THE PIECE

12-INCH MORTAR DRILL*

(Numbers refer to paragraphs in the 1914 Drill Regulations.)

THE PIT SECTION

110. Each pit of four mortars is manned by a pit section (88 enlisted men plus the reserve detachment) consisting of a pit commander, four mortar detachments, an ammunition detachment, and a reserve detachment.

111. Each mortar detachment (14 enlisted men) consists of a chief of detachment, an azimuth setter, an elevation setter, and 11 cannoneers numbered from 1 to 11, inclusive.

112. The ammunition detachment (31 enlisted men) consists of a chief of ammunition and 30 cannoneers numbered from 1 to 30 inclusive. This detachment is divided by the chief of ammunition into details for the service of powder and projectiles.

113. The reserve detachment consists of all unassigned cannoneers. It is posted by the pit commander at some convenient place, and is used by him to fill vacancies in the other detachments.

114. *To post the pit section.*—The section is posted as prescribed in detail in Par. 40. The pit commander commands *DETAILS, POSTS,* and after the cannoneers are posted, he commands *EXAMINE GUN.*

115. *To call off.*—The battery commander may at any time give the command *CALL OFF,* which is repeated by the pit commander. The cannoneers in each detachment call off their numbers, beginning at one.

116. *To load and fire.*—The battery commander indicates the target as prescribed in Chapter V. He designates the kind of projectile to be used and the mortars to be fired, and after the necessary data have been determined, commands *COMMENCE FIRING.*

The pit commander commands *LOAD* when the battery commander gives the command *COMMENCE FIRING* and before each shot or salvo of a series.

The battery commander may give the command *LOAD,* in which case the pit commander repeats the command. The pieces are loaded but are not fired until the battery commander commands *COMMENCE FIRING.* When the number of shots or salvos specified has been fired, the pit commander commands *CEASE FIRING.* When not specified, the battery commander commands *CEASE FIRING,* and the pit commander repeats the command.

117. When dummy ammunition is used, unless otherwise ordered, the mortars are unloaded at the command *CEASE FIRING.*

* For proposed drill, Model 1908, see page 127.

Details.	At command *DETAILS, POSTS.*	At command *EXAMINE GUN.*
Chief of detachment N.C. officer.	The chief of detachment takes post where he can supervise the mortar detachment.	The chief of detachment makes a careful inspection of the mortar and carriage, and reports to the pit commander.
Azimuth setter (N. C. Officer or private).	The azimuth setter takes post at the traversing cranks, facing the mortar.	The azimuth setter examines the azimuth index for adjustment by observing the mark made on the racer when the piece was last oriented, and examines and tests the traversing mechanism.
Elevation setter (N. C. officer or private).	The elevation setter takes post at the quadrant or elevation pointer, facing it.	The elevation setter examines the quadrant and tests the elevating mechanism, assisted by No. 5.
Breech detail. Nos. 1, 2, and 3. No. 1 is chief of breech.	No. 1 procures a wiper or cotton waste and a can containing lubricating oil and a sponge. He places the can convenient to the breech, and takes post one yard to the rear and right of the breech, facing it. No. 2 procures a wiper or cotton waste and the long lanyard (if a lanyard is used) which he coils with the hook on top and places convenient to the breech. He takes post one yard to the rear and left of the breech, facing it. No. 3 procures primers, primer pouch, punch, drill, reamer and firing mechanism, and takes post to the right of the breech, facing No. 1.	Nos. 1 and 2 remove the breech cover and place it at the designated place. No. 1 examines the breech mechanism, breechblock, breech recess chamber, and bore, and gives the necessary instructions for sponging if necessary. No. 2 examines the breech recess and gas-check seat, cleans and oils them, examines the long lanyard (if one is used,) and assists in sponging. No. 3 examines the vent and the firing mechanism. He clears the vent and cleans the primer seat.
Rammer detail, No. 4.	No. 4 procures the rammer and extractor, places the latter on the rack or prop, and takes post as prescribed for cover post, rammer vertical, head on the floor of the emplacement.	No. 4 places the rammer on the prop, and assists in sponging when necessary.

At command *LOAD.*	At command *RELAY.*	At command *CEASE FIRING* (When dummy ammunition is used.)
The chief of detachment supervises the work of his detachment, assists in ramming the projectile, verifies the laying of the piece in azimuth and elevation, and calling "*NO.——READY,*" takes cover after all of his detachment have taken cover. If his detachment is ordered to take cover before the piece is laid, he cuts it out of the firing circuit by opening the proper switch or by causing No. 2 to quit the lanyard when firing by lanyard. He observes the muzzle of his mortar when a salvo is fired, and in case of a misfire calls out *NO.——MISFIRE.*	The chief of detachment's duties are the same as at the command *LOAD.*	The chief of detachment supervises the work of his detachment.
The azimuth setter takes post at a run and traverses the piece rapidly to the nearest limit of the loading position, as indicated by a paint mark on the iron portion of the azimuth circle. He assists in ramming the projectile. He then traverses the piece as rapidly as possible to the azimuth setting posted.	The azimuth setter returns to the piece at a run and sets the piece for the new azimuth, and takes cover.	The azimuth setter traverses the piece to the nearest limit of the loading position, and assists in extracting the projectile.
The elevation setter takes post at a run, unclamps and depresses the piece to the loading position as rapidly as possible, but without shock, and sees that the spring latch is engaged. He sets the quadrant for the elevation as soon as it is posted, and assisted by No. 5 elevates rapidly to the approximate elevation. Then he sets the piece accurately, clamps it, and takes cover.	The elevation setter returns to the piece at a run and lays the piece for the new elevation, clamps it, and takes cover.	The elevation setter returns to the piece and proceeds as at the command *LOAD.*
Nos. 1, 2, and 3 take posts at a run. Nos. 1 and 2 open breech. No. 1 cleans and oils the breechblock, when necessary, and assists in ramming. He pushes the powder charge into the chamber by hand until its base barely clears the gas-check seat, and takes cover as soon as the breech is closed. No. 2 wipes any residue from the gas-check seat and breech recess and assists in ramming. He releases the tray latch, and closes breech. When the mortar is to be fired by lanyard, he attaches the long lanyard to the short one, straightens the lanyard after the detail has taken cover, and pulls it at the command *FIRE.* After the breechblock is completely closed, No. 3 inserts a primer in the vent, lowers the leaf of the firing device *completely down,* and commands *ELEVATE.* When the mortar is to be fired by lanyard he hooks the short lanyard *after the piece is elevated above 45 degrees,* and takes cover. As soon as the breech is open, after the piece is fired, he removes the old primer, clears the vent and cleans the primer seat.	No. 1 remains at *cover post.* No. 2 slacks his lanyard (if one is used). No. 3 remains at *cover post.* If the command *DRAW POWDER CHARGE* has been given also, Nos. 1 and 2 return to the piece at a run. No. 2 unhooks the short lanyard (if a lanyard is used) *before the mortar is depressed,* and as soon as the mortar is clamped in the loading position, No.3 removes the primer, and No. 1 opens breech. No. 2 withdraws the powder charge and passes it to No. 6 as soon as the latter has thrust in a new charge. No. 1 pushes the new one in place and No. 2 closes breech. No. 2 straightens out the long lanyard and stands ready to fire. No. 3 inserts a primer as prescribed at command *LOAD* and hooks the short lanyard *after the piece is elevated above 45 degrees.*	Nos. 1 and 2 proceed as at the command *RELAY, DRAW POWDER CHARGE,* until the powder charge is withdrawn. Then they assist in withdrawing the projectile. No. 3 returns to the piece, removes the primer as soon as the breech is opened, and assists in withdrawing the projectile.
No. 4 raises the rammer to a horizontal position, places the head against the projectile, and runs forward with the truck, and assisted by the chief of detachment, the azimuth setter, Nos. 1 and 2, rams the projectile home with all possible force as soon as the truck comes to rest with its buffer against the face of the breech. They withdraw the rammer quickly, and all quit the rammer except No. 4 who carries the rammer above his head, and takes post bringing the rammer to a vertical position.	No duties.	No. 4 carries the rammer to the prop and brings the extractor to the breech, assists in withdrawing the projectile, returns the extractor to the prop, and takes the rammer to his post.

Details.	At command *DETAILS, POSTS.*	At command *EXAMINE GUN.*
Elevating detail No. 5.	No. 5 takes post at the elevating wheel, facing it.	No. 5 removes the muzzle cover and places it at the designated place assists the elevation setter in testing elevating mechanism, cleans and oils the gear.
Powder serving detail, No. 6.	No. 6 procures a wrench for filling plugs, a measure containing hydrolene oil, and a funnel, and places them convenient to the piece. He then takes post near the entrance to the powder magazine.	No. 6 unscrews the filling plugs of both recoil cylinders and if oil is needed, fills them. Then he notifies the chief of detachment that the cylinders are ready for inspection. After the inspection he screws the filling plugs well home and replaces his implements.
Truck details, Nos. 7, 8, 9, and 10.	Nos. 7 and 8 bring out a loaded truck and run it to a point about 10 feet in rear of the breech, No. 7 on the right and No. 8 on the left. Nos. 9 and 10 run an empty truck alongside the delivery table in the shot gallery, No. 9 on the right and No. 10 on the left.	Nos. 7 and 8, 9 and 10, examine the trucks and clean and oil them.
Sponge detail, No. 11.	No. 11 procures the chamber and bore sponge and a vessel containing liquid for sponging, places the vessel well in rear of the pit, and holding the sponge with the head toward the pit, takes post near the vessel facing the pit. (When no firing is to take place the vessel may be empty.) The four numbers 11 align themselves to the right.	No. 11 brings up the chamber and bore sponge when called for by No. 1.

At command *LOAD*	At command *RELAY*.	At command *CEASE FIRING*. (When dummy ammunition is used.)
No.5 runs to the elevating handwheel and at the command *ELEVATE*, elevates rapidly to the approximate elevation and takes cover.	No. 5 returns to the piece at a run, elevates under direction of the elevation setter, and takes cover. If the command *DRAW POWDER CHARGE* has been given also, he proceeds as at the command *COMMENCE FIRING*, and takes cover as soon as the piece is again clamped in elevation.	No. 5 returns to the piece and proceeds as at the command *COMMENCE FIRING* until the piece is clamped in the loading position.
No. 6 receives the powder charge on a powder serving tray from a member of the ammunition detachment before leaving his cover post, and follows the truck to the breech. As soon as the truck has been removed, he inserts the tray into the breech recess, and as soon as the powder charge has been pushed into the chamber by No. 1, he withdraws the tray and takes his post at a run, carrying the tray with him.	No. 6 remains at *cover post* except when the command *DRAW POWDER CHARGE* has been given also, in which case he brings up the next charge and thrusts it in the chamber as soon as No. 2 has withdrawn the old one. He then receives the old charge from No. 2 and takes cover, turning over the old powder charge to a member of the ammunition detachment.	No 6 receives the powder charge from No. 2. and returns it to the ammunition detachment.
Nos. 7 and 8 (or 9 and 10) run a truck from the position of cover to the loading position (about ten feet in rear of the breech) and 9 and 10 (or 7 and 8) run a loaded truck from the gallery to the position of cover just vacated by 7 and 8 (or 9 and 10). At the proper time 7 and 8 (or 9 and 10) push the truck forward rapidly and bring it up against the face of the breech without shock, timing their arrival at the breech so as to clear the block as it is swung to *open*. As soon as the projectile has been rammed, they withdraw the truck promptly and run it backward into the shot gallery and alongside of the delivery table, roll a new projectile on the truck, and at the next shot run the reloaded truck rapidly to the position of cover just vacated by 9 and 10 (or 7 and 8), who have pushed their truck forward to the loading position.	No duties.	Nos. 7 and 8 (or 9 and 10) bring out empty truck from the gallery and when projectile is drawn back on to the truck return it to the gallery.
No. 11 dips the head of the sponge in the liquid for sponging, and allows the excess liquid to run off; after each shot, he rushes forward with the sponge and as soon as the breechblock is opened, sponges the chamber, assisted by the breech detail.	No duties.	No duties.

DUTIES OF THE EMPLACEMENT OFFICER

(For mortar batteries the term "pit" officer is authorized.)

118. In addition to the duties prescribed for the emplacement officer in Chapter IV, he observes the progress of the loading, and if it is apparent that either one or two pieces will not be laid in time, he commands NO. ———or *NOS.*———*TAKE COVER.* If it is apparent that more than two pieces will not be laid in time, he commands *RELAY* and reports to the battery commander. When two or more pieces are laid and all details have taken cover, he closes the safety switch (if firing by electricity) and reports or signals A (or B) *PIT READY* to the battery commander.

Should circumstances arise after he has reported or signaled *PIT READY* to the battery commander that, in his opinion, would make it unsafe to fire, he breaks the firing circuit (or causes lanyards to be dropped when firing by lanyard) and reports to the battery commander.

119. When there is no emplacement officer, the pit commander performs the duties prescribed for the emplacement officer in addition to his own duties.

120. The * * * * drill (page 121) is prescribed for each mortar detachment:

NOTES ON THE DRILL

121. At the command *TAKE COVER*, the mortar detachments take positions in rear of the pit, arranged in order from the right (No. 1 detachment on the right). Each detachment is in double column, as follows:

Elevation Setter		5
6		Azimuth Setter
2		1
4		3
(or 10) 8	Truck	7 (or 9)
	11	

122. The cover post for No. 4 is the same as his regular post, and the detachment forms on him at the command *TAKE COVER.* He does not quit the rammer except at the command *CEASE FIRING*, or when directed to do so, in which cases he places the rammer on the rack or prop.

123. When powder is not served from the rear of the pit, the cover post of No. 6 is near the entrance of the gallery from which powder is served.

124. In taking cover, the details proceed to their posts as rapidly as possible, but should avoid interfering with those whose duties at the piece have not been completed.

125. The service of the mortar is conducted habitually as though a salvo had just been fired (pieces elevated and detachments at cover post), but in case the command *COMMENCE FIRING* or *LOAD* is given when the details are at their posts and the pieces in the loading position, No. 6 proceeds at a run to the point designated for receipt of the powder charge.

126. When mortars are equipped for firing by electricity, they are fired by the emplacement officer at the signal of the battery commander. Mortars are fired by lanyard if the electrical firing circuit is not installed or is out of order. When the lanyard is used, the emplacement officer commands *FIRE* at the firing signal of the battery commander.

127. The chief of ammunition is in command of the ammunition detachment, and has charge, under the pit commander, of the galleries and magazines pertaining to his emplacement.

He is responsible for the condition of the projectiles, trolleys, delivery tables, and for the police of the galleries and magazines.

When the details are posted, he makes an inspection of the trolleys, magazines, and galleries and reports to the pit commander "Ammunition service in order," or reports defects he is unable to remedy without delay.

He is responsible that all trucks are loaded and delivery tables filled with projectiles at the beginning of an action. During drill or action he supervises the service of ammunition.

PROPOSED DRILL FOR MORTARS (MODEL 1908)*

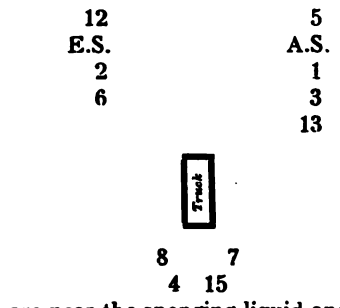
(See page 128)

NOTES ON THE DRILL

In order to agree with the drill, the following paragraphs should be amended as indicated:

Par. 110, change 88 to 104; Par. 111, change 14 to 18, 11 to 15, and 1 to 11 to 1 to 15.

Par. 121, the cover posts of the detachments must be changed as indicated below:



(Nos. 11 and 14 are near the sponging liquid and not shown here. Nos. 9 and 10 are at the entrance to the shot gallery with their truck.)

* This drill which is not yet official, was prepared by Captain G. A. Taylor, C.A. C. (who acknowledges indebtedness to Sergeant Stanley H. Black, 68th Company, C. A. C.) and was furnished for use in "Gunners Instruction" from the office of the Chief of Coast Artillery. Modified and corrected by Captain W. C. Baker, C. A. C., and Sergeant Stanley H. Black, for the 1917-18 edition.

Details.	At command *DETAILS, POSTS.*	At command *EXAMINE GUN.*
Chief of detachment (N. C. officer).	The chief of detachment takes post where he can supervise the mortar detachment.	The chief of detachment makes a careful inspection of the mortar and carriage and reports to the pit commander.
Azimuth setter (N. C. officer or private).	The azimuth setter takes post at the reading opening, facing the mortar.	The azimuth setter examines the azimuth index for adjustment, by observing the mark made on the racer when the piece was last oriented, and examines and tests the traversing mechanism.
Elevation setter (N. C. officer or private).	The elevation setter takes post at the quadrant and elevating hand wheel, facing the piece.	The elevation setter examines the quadrant, and tests the elevating mechanism and the quick loading mechanism, assisted by Nos. 5 and 12.
Breech detail, Nos. 1, 2, and 3: No. 1 is chief of breech.	No. 1 procures a wiper or cotton waste and a can containing lubricating oil and a sponge. He places the can convenient to the breech, and takes post 1 yard to the rear and right of the breech, facing it. No. 2 procures a wiper or cotton waste and the long lanyard (if a lanyard is used), which he coils with the hook on top and places convenient to the breech. He takes post 1 yard to the rear and left of the breech, facing it. No. 3 procures primers, primer pouch, punch, drill, reamer and firing mechanism, and takes post to the right of the breech, facing No. 1.	Nos. 1 and 2 remove the breech cover and place it at the designated place. No. 1 examines the breech mechanism, breechblock, breech recess, chamber, and bore, and gives the necessary instructions for sponging. No. 2 examines the breech recess and gas-check seat, cleans and oils them, examines the long lanyard (if one is used), and assists in sponging. No. 3 examines the vent and the firing mechanism. He clears the vent and cleans the primer seat.
Rammer detail Nos. 4 and 15(whose only duty is to assist in ramming).	No. 4 procures the rammer, and takes post as prescribed for cover post, rammer vertical, head on the floor of the emplacement. No. 15 procures the extractor and prop, places the former on the latter, and takes post as prescribed for cover post.	No. 4 places the rammer on the prop, and assists in sponging, when necessary.

At command *LOAD.*	At command *RELAY.*	At command *CEASE FIRING.* (When dummy ammunition is used.)
The chief of detachment supervises the work of his detachment, assists in ramming the projectile, signals *ELEVATE* to No. 12 after primer is inserted and firing leaf lowered, and calling No. . . . READY, takes cover after all of his detachment have taken cover. If his detachment is ordered to take cover before the piece is laid, he cuts it out of the firing circuit by opening the proper switch or by causing No. 3 to quit the lanyard, when firing by lanyard. He observes the muzzle of his mortar when a salvo is fired, and in case of misfire calls out No. . . *MISFIRE.*	The chief of detachment's duties are the same as at the command *LOAD.*	The chief of detachment supervises the work of his detachment.
The azimuth setter takes post at a run and supervises the rapid traversing of the piece by No. 13 to the nearest limit of the loading position, as indicated by paint marks on the racer and the iron rim of the loading platform. He then sees that the piece is traversed as rapidly as possible to the azimuth setting posted.	The azimuth setter returns to the piece at a run and sees that the piece is set for the new azimuth, and takes cover.	The azimuth setter has the piece traversed to the nearest limit of the loading position.
The elevation setter takes post at a run, stopping on the way to unlock the piece from the cradle, sets the quadrant for the elevation as soon as it is posted, brings the cradle to this elevation, and takes cover after the piece is locked in the cradle and he has verified the elevation.	The elevation setter returns to the piece at a run and lays the piece for the new elevation, and takes cover.	The elevation setter returns to the piece and proceeds as at the command *LOAD.*
Nos. 1, 2, and 3 take posts at a run. No. 1 cleans and oils the breechblock, when necessary, and assists in ramming; and takes cover as soon as the breech is closed. No. 2, standing astride the chassis, lowers the locking lever and unhooks the short lanyard from the firing leaf and hooks it into the safety device during the depression of the mortar; opens breech; wipes any residue from gas-check seat and breech recess; pushes powder charge off tray of truck into the powder chamber at the command *POWDER;* and closes breech. (Note. Command *POWDER* is given by emplacement officer after zone has been displayed and powder verified.) After the breech is completely closed, No. 3 inserts a primer in the vent and lowers the leaf of the firing device *completely down.* When the mortar is to be fired by lanyard he hooks the short lanyard *after the piece is elevated above* 45°, attaches the long lanyard to the short one, straightens the lanyard, after the detail has taken cover, and pulls it at the command *FIRE.* As soon as the breech is open, after the piece is fired, he removes the old primer, clears the vent and cleans the primer seat.	Nos. 1 and 2 remain at *cover post.* No. 3 slacks his lanyard (if one is used). If the command *DRAW POWDER CHARGE* has been given also, No. 2 returns to the piece at a run. No. 3 unhooks the short lanyard (if a lanyard is used) before the mortar is depressed, and removes primer before breech is opened. As soon as the mortar is locked in the loading position, No. 2 opens the breech, withdraws the powder charge and passes it to No. 6, as soon as the latter has thrust in a new charge and pushed it in place. No. 2 then closes breech. No. 3 hooks the short lanyard after the piece *is elevated above* 45°, straightens out the long lanyard and stands ready to fire.	No. 1 returns to the piece, and assists in withdrawing the projectile. Nos. 2 and 3 proceed as at the command *RELAY, DRAW POWDER CHARGE,* until the powder charge is withdrawn. No. 3 removes the primer as soon as the breech is opened. Then Nos. 2 and 3 assist in withdrawing the projectile.
No. 4 raises the rammer to a horizontal position, places the head against the projectile and runs forward with the truck, and assisted by the chief of detachment, Nos. 1 and 15, rams the projectile home with all possible force, as soon as the truck comes to rest with its buffer against the face of the breech. They withdraw the rammer quickly, and all quit the rammer, except No. 4, who carries the rammer above his head and takes post bringing the rammer to a vertical position.	No duties.	Nos. 4 carries the rammer to the prop and brings the extractor to the breech, assists in withdrawing the projectile, returns the extractor to the prop, and takes the rammer to his post.

Details.	At command *DETAILS, POSTS.*	At command *EXAMINE GUN.*
Elevating detail, Nos. 5 and 12.	Nos. 5 and 12 take post at the quick-loading elevating hand-wheels facing them, No. 5 on the right, No. 12 on the left.	No. 5 removes the muzzle cover and places it at the designated place, and, together with No. 12, assists the elevation setter in testing the quick-loading elevating mechanism, cleans and oils the gears.
Powder - serving detail, No. 6.	No. 6 procures a wrench for filling plugs, a measure containing hydrolene oil, and a funnel, and places them convenient to the piece.	No. 6 unscrews the filling plugs of both recoil cylinders and, if oil is needed, fills them. Then he notifies the chief of detachment that the cylinders are ready for inspection. After the inspection he screws the filling plugs well home, replaces his implements, and takes post at the entrance to the powder magazine.
Truck details, Nos. 7, 8, 9, and 10.	Nos. 7 and 8 bring out a loaded truck and run it to a point about 10 feet in rear of the breech, No. 7 on the right and No. 8 on the left. Nos. 9 and 10 run an empty truck to the entrance of the shot gallery. No. 9 on the right and No. 10 on the left.	Nos. 7 and 8, 9 and 10, examine the trucks and clean and oil them.
Sponge detail, Nos. 11 and 14.	Nos. 11 and 14 procure the chamber and bore sponge and a vessel containing sponging liquid, place the vessel well in rear of the pit, and holding the sponge with the head toward the pit, take post near the vessel facing the pit. When no firing is to take place the vessel may be empty.) The eight Nos. 11 and 14 align themselves to the right.	No. 11 assisted by No. 14 brings up the chamber and bore sponge, when called for by No. 1.
Traversing detail No. 13.	Nos. 13 takes post at the traversing crank, facing the azimuth setter.	No. 13 assists in examining and testing the traversing mechanism.

At command *LOAD*.	At command *RELAY*.	At command *CEASE FIRING*. (When dummy ammunition is used.)
Nos. 5 and 12 run to the elevating handwheels, and at the command *ELEVATE*, elevate rapidly, slowing up just before the piece locks.	If the command *DRAW POWDER CHARGE* is given also, Nos. 5 and 12 depress the piece to the loading position and elevate again at the signal of the chief of detachment.	Nos. 5 and 12 return to the piece and depress it to the loading position.
No. 6 receives the powder charge from a member of the ammunition detachment before leaving his cover post, and follows the truck to the breech. As soon as the projectile is rammed and the rammer withdrawn, he places the powder charge on the tray of the breech and returns to his post at a run.	No. 6 remains at *cover post* except when the command *DRAW POWDER CHARGE* has been given also, in which case he brings up the next charge and thrusts it in the chamber as soon as No. 2 has withdrawn the old one. He then receives the old charge from No. 2 and takes cover, turning over the old powder charge to a member of the ammunition detachment.	No. 6 receives the powder charge from No. 2, and returns it to the ammunition detachment.
Nos. 7 and 8 (or 9 and 10) run a truck from the position of cover to the loading position (about ten feet in rear of the breech) and 9 and 10 (or 7 and 8) run a loaded truck from the gallery to the position of cover just vacated by 7 and 8 (or 9 and 10). At the proper time 7 and 8 (or 9 and 10) push the truck forward rapidly and bring it up against the face of the breech without shock, timing their arrival at the breech so as to clear the block as it is swung to *open*. As soon as the projectile has been rammed, and powder inserted, they withdraw the truck promptly and run it backward to the entrance of the shot gallery, place a new projectile on the truck, and at the next shot run the reloaded truck to the position of cover just vacated by 9 and 10 (or 7 and 8) who have pushed their truck forward to the loading position.	No duties.	Nos. 7 and 8 (or 9 and 10) bring out empty truck from the gallery and, when projectile is drawn back onto the truck, return it to the gallery.
No. 11, assisted by No. 14, dips the head of the sponge in the sponging liquid and allows the excess liquid to run off; after each shot, they rush forward with the sponge, and, as soon as the breechblock is opened, sponge the chamber.	No duties.	No duties.
No. 13 takes post at a run and traverses the piece under direction of the azimuth setter.	No. 13 returns to the piece at a run, and traverses the piece under the direction of the azimuth setter.	No. 13 traverses the piece under direction of the azimuth setter.

APPENDIX "I"

EXTRACTS FROM D. R. C. A., 1914

II. Organization

22. A gun company will be divided into sections as follows: one range section, and for each emplacement, one gun section. The sections will be subdivided into detachments and details for manning the matériel to which assigned.

23. A mortar company will be divided into sections as follows: One range section, and for each pit, one pit section. The sections will be subdivided into detachments and details for manning the matériel to which assigned.

25. The senior noncommissioned officer of each section, detachment, or detail is its chief. Each chief will command his subdivision and will be responsible for its drill, its efficiency, and the condition of the matériel to which it is assigned.

MARCHING MANEUVERS

The company is formed and marched off according to drill regulations. (Paragraphs 37 to 39).

To Post the Sections

40. The company commander marches his company to its battery or station, and as he approaches the battery or station commands *SECTIONS POSTS.* At the second command, each chief of section falls out of ranks, marches his section to a point near its emplacement or station, and commands *DETAILS POSTS.* At the second command all details fall out, procure equipments and implements, and take their posts.

Each chief of section determines whether all apparatus and material to be served by his section is in order, and reports to the officer directly over him, "Sir———in order" or reports defects he is unable to remedy without delay. As soon as the chiefs of section have reported, the officers report to the battery commander, who then reports to the fire commander "——— in order" (inserting name of battery), or reports defects he is unable to remedy without delay. (The reports from mine companies are made to the mine commander.)

If he so desires, a company commander may post the sections separately, at any point of the march, by commanding:———*SECTION, POST.* The section designated is posted as described above.

When a range section leaves the column, the range officer falls out and proceeds direct to his station.

Details for remote stations may be marched to their stations from the company parade by their respective chiefs.

To Dismiss the Sections

41. Battery commanders command *DISMISSED.* Range officers command *CLOSE STATION* (or *CLOSE STATIONS*). Emplacement officers command *REPLACE EQUIPMENTS.* Chiefs of sections command

FORM SECTION. The company is formed on the battery parade and is marched by the battery commander to the company parade and dismissed.

Subdivisions from remote stations are marched to the company parade and dismissed by their chiefs.

III. General Duties

OBSERVERS

61. Observers will be selected on account of their special aptitude. They will understand thoroughly the use of their instruments and will have a knowledge of the general characteristic features of warships. Each observer is responsible for the care and adjustment of his instrument and for the police of his station at all times, and will report to the range officer deficiencies, defects, or accidental damages as soon as they are known.

62. Ranges to moving targets as determined by depression position finders and coincidence range finders will be compared frequently (if practicable) with ranges as determined by a long horizontal base.

63. Observers will be tested frequently as to their proficiency in the practical use of the instruments to which assigned. The test will be conducted so as to determine the relative ability of various observers to read quickly and accurately ranges to fixed and moving objects.

THE GUN AND PIT COMMANDERS

69. Each emplacement of a gun battery is commanded by a gun commander and each pit of a mortar battery by a pit commander, who is responsible to the emplacement officer for the condition of the matériel and the efficiency of the personnel of his section. The gun (or pit) commander will supervise the gun cleaning and will require the mechanic to keep pieces and carriages in excellent condition. He will supervise the service of the piece.

70. The gun (or pit) commander will have charge of the entire emplacement under the emplacement officer, and during the absence of the emplacement officer, he will perform the duties prescribed for the emplacement officer. After the details have been posted as prescribed in Paragraph 40, he will command *EXAMINE GUN.* He will make a general inspection of the gun and carriage, paying especial attention to the recoil cylinders, the firing device, and the oiling of the various bearings. He will report to the emplacement officer, "Sir, No.———(or pit)——— in order," or will report defects he is unable to remedy without delay.

71. At the conclusion of the exercises for the day, he will command *FORM SECTION* after the emplacement officer has commanded *REPLACE EQUIPMENTS* (Par. 41). He will supervise the replacing of equipments and implements, will see that the piece is secured, and will then form his section on the battery parade.

THE GUN POINTER

72. A gun pointer is assigned to each gun in commission and is responsible for the condition and adjustment of the sight and sight standard. He will have a general knowledge of the characteristic features of warships. He will be tested frequently as prescribed in Par. 224.

THE MECHANIC

73. One mechanic, or acting mechanic, is assigned, under the gun commander, to each 8-inch (or greater caliber) gun emplacement, to each mortar emplacement, and to each battery of the intermediate or minor armament in

service. He is in immediate charge of all small stores and supplies at the emplacement or battery to which assigned.

GENERAL INSTRUCTION

203. The service of the piece will proceed with alertness and precision, and with as few orders as possible; aside from the necessary orders and instructions, no talking of any kind will be permitted. All movements of the cannoneers connected with the service of the piece will be made at a run.

206. At the command *TAKE COVER*, given at any time, all cannoneers not designated to remain at their posts will move at a run to some designated place under cover. As a rule this command will be given in mortar batteries only.

207. A drill primer or a fired service primer will be used at drill.

208. The primer will be inserted after the breechblock is locked. The cannoneer who inserts the primer will be instructed to exercise the greatest care in lowering the leaf of the firing device. Under no circumstances will he insert or remove the primer by means of the button or wire.

209. Service friction primers are adjusted in manufacture to require a pull of about 25 pounds to start the wire to the rear, and about 40 to 45 pounds to pull the teeth through the compressed friction pellet and explode it.

210. The lanyard will be pulled from a position as near the rear of the gun as possible. A strong, quick pull (not a jerk) with as short a lanyard as practicable, will be used.

211. Obturating primers are constructed so that when a primer is pulled and fails to fire, the primer wire is free to move forward without causing the composition to ignite. Extra precaution will be taken to prevent any attempt to use a primer that has failed.

212. Constant inspection of the safety pin on the firing leaf of the breech mechanisms in which combination primers are used will be made, since if the safety pin should be broken by harsh treatment and the pull upon the lanyard be upward by about 10° the primer probably would be ejected at the instant of firing and might injure the man firing the piece.

213. *Signals.*—The commands or signals, *ELEVATE*, *DEPRESS*, *RIGHT*, or *LEFT*, given in pointing, always refer to the direction of motion of the muzzle.

ELEVATE.—Raise either hand to the height of the head, fingers pointing upward.

DEPRESS.—Raise either hand to the height of the head, fingers pointing downward.

RIGHT or *LEFT.*—Motion with either hand, fingers pointing in the desired direction.

CLAMP.—Raise either hand with fist closed opposite neck, back of hand up, elbow bent and at height of shoulder.

HALT.—Raise and fully extend either arm vertically, hand and fingers open in prolongation of arm.

STAND FAST.—Raise and fully extend either arm horizontally straight to the front, hand and fingers open in prolongation of arm, back of hand up.

TAKE COVER.—Raise and extend fully both arms horizontally in prolongation of line of shoulders, hands open, fingers extended and joined, backs of hands up.

READY.—Raise either hand horizontally in front of forehead, fingers extended and joined, back of hand against forehead.

Care in Seating the Projectile at Gun Batteries of the Major Armament

215. The shot truck carrying the projectile will be brought up to the face of the breech and the projectile pushed carefully off the truck until the base of the projectile is just inside the powder chamber. The truck will then be withdrawn and run off to one side. The entire ramming detail will then man the rammer as near its outer end as possible. At the command *HOME RAM* by the chief of breech, the ramming detail will rush the projectile forward hard into its seat, increasing the speed of the rush so that the projectile will have its fastest movement when it comes up hard in its seat.

216. *Powder serving tray.*—For guns of the major and the intermediate armament, there will be made wooden serving trays, each having sufficient dimensions to carry all the sections of one powder charge. The tray will be so shaped that the forward end will cover the screw threads in the breech, and it will be provided with cross handles to facilitate handling. Powder sections will be arranged in the same order they will have in the powder chamber.

217. As soon as the rammer has been withdrawn after seating the projectile, the nose of the powder serving tray will be inserted in the breech by the powder servers, and the rammer detail, in one motion, will push carefully the entire powder charge off the serving tray to such a distance that the breech block will give the powder charge a final push into the chamber in closing. The tray will then be removed and the breech closed. At least two trays will be provided for each gun.

METHODS OF POINTING

223. Case I.—This method of pointing is used only with rapid-fire guns where means for laying in elevation by quadrant have not been provided.

Direction and elevation are given by the sight.

The gun pointer adjusts the sight in its seat and sets the elevation and deflection scales for the indicated range and deflection, respectively.

Case II.—This is the normal method of pointing all guns. Direction is given by the sight, and elevation by an elevation or range scale attached to the carriage. For guns of the major armament the corrected range is taken from the time-range board. The gun pointer sets his sight to the deflection shown on the deflection recorder's board.

Case III.—This method of pointing is used exclusively for mortars. Its use for guns is auxiliary and is limited to batteries where the prevalence of fog or other local conditions render it necessary. Direction is given by the azimuth circle and elevation by the elevation scale or by quadrant.

In Case III, guns are fired on the bell. Corrected azimuths for the first or second bell after the data are received, are sent to the guns every thirty seconds. The gun pointer sets the azimuth for the bell on which it is desired to fire. The corrected range of the set-forward point for the same instant of firing is taken from the time-range board.

Pointing Tests

224. Pointing tests will be held frequently at gun batteries of the major armament in the following manner:

An assumed deflection for wind and drift is used during the test. This deflection is changed frequently during the drill so that gun pointers may not know the reading that should be obtained at the end of the time of flight. To accomplish this, the platen of the deflection board is set for the assumed

Deflection, and the setting is not changed as long as the same assumed deflection is used.

The gun pointer sets his sight at the deflection received from the plotting room, which is that obtained from the deflection board by combining the correction for angular travel during the time of flight with the assumed deflection for wind and drift. He gives the command *FIRE* as soon after the command *READY* as he is on the target; traversing is stopped and he then follows the target with the vertical wire. A noncommissioned officer equipped with a stop watch and a time of flight table starts the watch at the command *FIRE*, commands *HALT* and stops the watch at the expiration of the time of flight. The gun pointer stops following with the vertical wire at the command *HALT*, when the reading of the deflection scale should be the same as the assumed deflection for wind and drift. If not, the difference is the error in predicting and pointing.

Example.—Assumed deflection, 3.65; deflection sent to gun pointer, 3.20; reading of the deflection scale at end of time of flight, 3.60. 3.65−3.60 =0.05, the error.

For each trial, records will be kept of the range to the target and the deflection error; and the gun pointer will be informed concerning the amount of his error.

225. The excellence of a gun pointer's work is determined, first, by the accuracy of his pointing; second, by the promptness with which he is able to give the command *FIRE* after the piece is ready.

226. With disappearing guns it is important that the gun pointer be trained to get on the target in the time necessary to close the breech plus the tripping interval, so that in practice or action no time will be lost in pointing the gun after it is in battery.

Prediction Tests for Mortar Batteries

227. Prediction tests will be made frequently at mortar batteries in the following manner:

The battery commander is assisted by an officer, or noncommissioned officer, equipped with a stop watch and a time-of-flight table. The azimuth of a predicted point and the corresponding time of flight is sent to the battery commander, who sets his instrument to the azimuth of the predicted point, the vertical wire at normal. As the target passes the vertical wire of his instrument, he commands *FIRE*, and follows the target by turning the disc crank. The assistant starts the stop watch at the command *FIRE* and calls "halt" at the expiration of the time of flight. The battery commander ceases tracking and the assistant records the reading of the instrument.

The difference between this reading and the azimuth of the set-forward point as determined from the plotting board is the error in prediction.

Example.—Time of flight, 46⅔ seconds; azimuth of predicted point, 217.40°; azimuth of set-forward point, 214.49°; reading of the azimuth instrument, 214.59°; error in prediction, 0.10°.

Records of these tests will be kept and the results will be published to the battery command.

IV. Target Practice

PRECAUTIONS FOR SAFETY

233. Powder marked for one caliber or piece will not be used for any other caliber or piece of different chamber capacity.

238. When service ammunition is fired from guns (or mortars) above 4.7" in caliber, or when blank ammunition is fired from guns (or mortars) of any caliber, the powder chamber will be sponged and the mushroom head wiped off after each round and before loading for the next round, in order to insure the extinguishment of all sparks and the removal of smouldering fragments. The sponge and cloth used for this purpose will be dipped in liquid for sponging and the surplus liquid will be removed from them before they are used.

240. When firing, officers and men will be advised to place the authorized ear protectors, cotton, or small pieces of waste in their ears, but they will not be permitted to place the finger tips in their ears.

242. In case of a misfire in artillery practice the primer will not be removed and a new one inserted for at least ten minutes; during the interval, the piece will be laid on some portion of the field of fire where its discharge will not endanger shipping.

243. If firing by electricity, the circuit will be broken before the primer is removed. When using fixed ammunition and percussion primers, a second trial of the primer will be made if the firing device can be cocked by hand without opening the breech, but if this also fails, the breech will not be opened and a new cartridge substituted within ten minutes. If it is found necessary to open the breech when using obturating primers, the vent will be examined and cleared if necessary and the rear section of the powder charge will be pulled a little to the rear so that the mushroom head will push it to its place; the breech will be closed, and another primer will be tried.

244. At the command *CEASE FIRING*, lanyards will be detached. If using electric primers, the circuit will be broken. With rapid-fire guns using metallic cartridge cases, the breech will be opened. If firing is not to be resumed, fixed ammunition and separate powder charges will be withdrawn. Projectiles not loaded and fused will be driven back and withdrawn. Separate projectiles loaded and fused will be left in the gun until a favorable time to fire them; on no account will an attempt be made to drive them back.

SERVICE PRACTICE

235. Projectiles will be cleaned carefully before being inserted in the bore, lubricant will be removed, and the bourrelets will be freed of paint.

236. Immediately after a piece is fired, the breech will be opened and the primer will be removed.

237. Care will be taken to prevent injury to the gas-check seat and to keep it clean. If any residue from the priming charge drops from the obturator into the gas-check seat or the breech recess it will be wiped off.

239. Immediately after firing, the piece and accessories will be inspected by the battery commander and a report on their condition will be made by him (through the fire and fort commanders) to the coast defense commander. The bores of pieces will be washed clean with water, dried and oiled. The breechblocks will be dismantled, and all parts cleaned and oiled.

V. Care of Material

412. Coast defense structures, and the grounds surrounding them whose limits are prescribed by fort commanders, will be kept in proper police.

413. All open drains or gutters will be carefully swept at least once a week, and the sweepings so disposed of that they will not be carried back by wind and water.

414. Under no circumstances will drains, gutters, sumps, counter-weight wells, etc., be used as places of deposit for sweepings, waste, rags, and other rubbish. Drains and sumps will be inspected weekly, and will be kept in good order. Water fixtures will be inspected weekly, and leaky fixtures will be promptly repaired to avoid waste of water and possible damage.

421. The ammunition-service apparatus (trolleys, motors, and hoists) will be operated at least once each week, and the different working parts (pulleys, journals, etc.) will be kept clean and lubricated. Special care will be exercised in operating the motor starter and in preventing the jamming of any part of the hoists; also in the handling of projectiles at the receiving and delivery tables. The Hodges ammunition hoist is not designed and must not be used for lowering projectiles, either by motor or by hand power. The Taylor-Raymond ammunition hoist may be used with safety to lower projectiles by hand power, provided care be exercised and the hoist operated slowly; but the hoist must not be used to lower projectiles by motor power. Where emplacements are provided with cranes these will be used in preference to the Taylor-Raymond hoist for lowering projectiles.

For care of hoists, see Engineer Mimeographs, Nos. 46 and 137, and supplements.

423. *Oils* (see Ordnance Pamphlet No. 1869).—The important oils and lubricants supplied and uses therefor are shown in the following table:

Name	Use
Hydrolene	For filling recoil cylinders.
Kerosene	For cleaning purposes only, especially recoil cylinders.
Light slushing	For the bore, and for the bright parts of guns and carriages, when they are to remain unused for a considerable time.
Engine	For bright parts of guns and carriages when in daily use. For lubricating purposes where oil holes or plugs are provided.
No. 4½ Lubricant	For filling grease cups of heavy bearings.
Turpentine	For thinning paint.
Clock	For bearings of sights, position finders, etc.
Graphite	For use on heavy bearings in connection with 4½ lubricant, proportion 5% graphite to 95% lubricant *by volume*. Also for use on gas-check pads, proportion 50% graphite and 50% lubricant by *weight*.

Oils will be kept in closed receptacles, free from contamination, and will not be used a second time unless strained carefully. Discoloration does not in itself affect the serviceability of oils.

440. After firing, the powder residue will be removed by using the sponges well saturated with water. The sponges will be covered with sufficient burlap to make them a snug fit and insure reaching the bottoms of the rifling grooves. Flushing the bore with a hose immediately after firing facilitates cleaning.

441. The habitual position of guns on disappearing carriages will be "from battery." Guns on barbette carriages will be given an elevation of 5°.

442. All mortars (except model 1908) will be elevated habitually so that their axis will be parallel to the piston rod. The breech cover will be left off and the translating roller will be left in place. At forts where the sand blows into the breech mechanism and at all forts during the cold season where snow and ice may collect and form around the breech mechanism, the mortar will be kept elevated about 5° with the breech cover on. Model 1908 mortars will be kept elevated about 5° with the breech cover on.

443. *Care of carriages.*—When in use, all bearing parts will be cleaned and lubricated thoroughly. In all carriages, special attention will be given to the lubrication of gun trunnions, rollers, pintle surfaces, sliding surfaces, elevating, loading, and traversing mechanisms, including the teeth of all gears. On disappearing carriages, the following parts will be lubricated also: Gun-lever axle bearings, crosshead pins, tripping and retracting mechanisms, elevating rack and band trunnions, and crosshead guides.

Oil holes where provided will be cleaned out frequently to keep them free from sand and grit, and kept closed habitually by the screw plugs or covers provided, except during oiling.

Before oiling at any oil hole, wipe off carefully any dirt or grit near the opening that might be carried down into the bearing by the oil.

444. Compression grease cups will be filled with No. 4½ lubricant. The caps will then be screwed down on the cup until the spring rod projects about 0.25 inches above the top of the cap. This adjustment will be made from day to day, as required to maintain about this projection for the rod.

445. Care will be exercised that no water is allowed to enter the recoil cylinders when they are filled with oil or at any other time, for this will cause rusting of the interior of the cylinders, and in cold weather, it may freeze and burst the equalizing pipes or other parts of the recoil system.

448. All motors installed on gun carriages will be operated at least once each week if practicable for such length of time as will insure that they are in working order. When exposed to excessive moisture they will be operated for such further length of time as may be necessary to prevent accumulation of moisture in the motor cases.

450. On all seacoast gun carriages special care will be exercised to insure that bolts passing into hydraulic cylinders are tight at all times.

458. *Examination of the breech mechanism of mounted guns.*—The breech mechanism of mounted guns will be operated at least once each week, when practicable, and such parts of it as need cleaning will receive proper attention. If necessary, the tray will be removed in order to clean the worm, worm shaft, the spiral gear, and their recesses.

459. The mechanism will be oiled frequently, especially the filling-in disk, the worm shaft, ball bearings, and the hinge pin; engine oil is issued for this purpose. A mixture of 4½ lubricant and graphite is used on translating rollers. Special care will be taken to keep the primer seats clean and well oiled. Neglect of this permits rust, the removal of which enlarges the seat sufficiently to cause primers to stick.

460. *Firing mechanisms.*—Firing mechanisms will not be left on any gun or mortar out of service, but will be kept dismantled in the box provided for the purpose. All parts will be kept oiled and entirely free from dust.

461. *Piling projectiles.*—Projectiles when received at a fort will be unboxed and piled on suitable skidding with points to the wall, base out, so

that they may be inspected and fused easily. Care will be taken not to injure rotating bands. Should any rotating bands be found to be deformed, the raised portions will be filed down to the general exterior contour of the band. (See pars. 569 to 574, inc.)

465. *Dummy projectiles.*—Dummy projectiles, in order to work well, require that the bands be reasonably round and of sufficient diameter to make the projectile seat at about the position in the gun originally intended, and that the springs be of full strength. A little kerosene will be poured under the rotating band before each day's drill to cut any rust which may have formed and thus insure uniform conditions from day to day. The detailed methods of caring for these projectiles, outlined in Ordnance Pamphlet 1872, will be followed.

466. *Care of* * * * *primers.*— * * *

All obturating electric and friction primer cases will be cleaned immediately after firing and turned in to the coast defense ordnance officer for shipment to an arsenal.

VI. Storage and Care of Explosives

General Instructions

479. All dirt, grit, and foreign material will be removed from cases before placing them in storage. In handling cases containing explosives, they will be raised, carried to the new position, and gently lowered. Rolling, sliding, or dropping cases must be avoided.

480. One of the most important requirements in the care of any explosive is absolute cleanliness in and about the place where the explosive is stored. By removing all foreign materials from a magazine, the chances of accidents are reduced. The ground around the storage place will be kept free from leaves, long grass, brush, débris, or anything which may increase the fire risks.

481. Officers charged with the receipt and storage of explosives will direct personally the work of handling the cases.

482. Cases will never be exposed to the direct rays of the sun longer than is absolutely necessary. They will be covered with a paulin or similar cover in such a way as to admit of the free circulation of air. The effect of the direct rays of the sun on a metallic case is to raise the temperature inside the case to a point considerably above that of the open air, and this temperature is maintained for a considerable time after the exposure.

483. In opening cases, implements which may produce sparks will not be used. Suitable implements are a wooden mallet, or a copper hammer with a wooden wedge or copper chisel. A hammer will be used only when necessary, and then as lightly as possible.

484. The keys of magazines and storage places will be kept in the hands of thoroughly reliable and responsible persons.

485. Whenever there is more than one kind of explosive in a storage place, but one kind will be placed in a pile, and the different kinds separated as much as possible.

486. The date of the receipt of any explosive at a fort will be marked on the outside of the container. Each separate package will be marked.

487. Only those explosives mentioned herein as being suitable for storage together will be placed in any single storage place.

488. Free circulation of dry air is most desirable in any place where explosives are stored. Cases will always be raised off the floor of the storage

place and placed on skids.

489. If a storage place is artificially heated, or from climatic conditions the temperature of the air is liable to rise above 85° F., a maximum thermometer will be suspended therein, the temperature will be watched carefully during the period of excessive heat, and the daily readings will be recorded on the proper Ordnance Department form. Should a temperature as high as 100° F. be maintained for any length of time, the place will be cooled or the explosive removed.

490. Black powder is now supplied to the service in relatively small quantities. It will never be stored with other explosives. It will be kept dry, and on account of the danger of explosion by ignition will be protected thoroughly from all fire risks.

491. Matches and unauthorized lights will not be permitted in any magazine.

492. No loose explosive will be permitted in any building, except such as is being used actually in preparing charges.

493. Empty ammunition cases will never be stored with filled cases.

494. A copy of these instructions will be hung in a convenient place in every magazine containing explosive, for the information and guidance of all concerned.

EXPLOSIVE D

Package

513. Explosive D is at present contained in double paper bags containing about 100 to 125 pounds of explosive. These bags are inclosed either in the standard cartridge storage cases or in strongly hooped wooden barrels painted inside with ruberine or other authorized paint. That manufactured in future will probably be packed in boxes as described for trotol.

Storage and Care

514. This explosive will be stored in a perfectly dry place, preferably in a magazine, as it has a slight tendency to absorb moisture. If it is impracticable to store in a magazine, the explosive may be stored in the dryest place available where it is protected thoroughly from all fire risks.

515. The barrels will be stored on end, marked end uppermost.

516. No cards or other material will be tacked on the barrel.

517. No nails will be driven in the barrel.

518. If from any cause the barrels of explosive are wet and there is a reasonable assurance that the interior has become wet, a barrel will be selected and opened. If the interior is wet, a full report of the circumstances will be made to the War Department. If the interior is dry, the barrel will be reheaded carefully and all barrels will be dried in the open air out of the direct rays of the sun.

519. Explosive D may be stored with wet gun cotton (15 per cent water based on dry weight of explosive), dynamite and trotol.

Inspection of Forts

520. No technical inspection of this explosive will be made at forts except by the Ordnance Department. Inspection at forts will ordinarily be limited to seeing that the rules for storage and care are strictly observed.

521. Barrels will not be opened for the purpose of inspecting the contents, except as indicated above.

522. If any barrel shows signs of drying out or opening at the staves or head, all barrels will be given a coat of ruberine or other authorized paint.

FUSES AND PRIMERS

Package

523. Fuses and primers are packed in hermetically sealed metallic boxes, inclosed in suitable wooden containers. These boxes will not be opened until the fuses and primers are required for use.

Storage and Care

524. Cases of fuses and primers may be stored in any place which is available, provided it is cool, dry, secure from entrance by unauthorized persons, and not subjected to a temperature greater than 100°F.

525. All boxes containing fuses will be marked with metal labels, obtained from the Ordnance Department, clearly indicating the projectiles to which the fuses are assigned.

526. Under no circumstances will fuses and primers be stored with other explosives, except the commercial detonators used in submarine mines.

527. Fuses will not be disassembled for any purpose. Such action by inexperienced persons is liable to result in explosion.

Inspection

528. The inspection of this class of explosives will be limited to seeing that the requirements of storage and care are observed strictly.

SMOKELESS POWDER

Package

553. Powder charges are now supplied to forts in hermetically sealed cases and will be opened only in accordance with War Deparment instructions.

Storage and Care

554. Smokeless powder will be stored in the driest available magazines. So long as the container remains sealed, the only effect of water is to cause unusual deterioration of the case.

555. No magazine in which the temperature of the air rises above 95°F. will be used for the storage of smokeless powder.

556. Powder storage cases containing propelling charges will normally be piled on end with skids under the first tier and each succeeding tier. This arrangement may be departed from in case special facilities for piling the cases in some other manner are provided or in case the length of the storage case is so great relative to the diameter that there is danger of tiers falling down. If cases are piled on the side for any reason, particular care should be taken to separate them by skids rounded out to fit the contour of the case, as experience has shown that the piling of cases on their sides, either without skids or with ordinary skids, has a tendency to break the seals of the cases, causing them to leak.

557. Notwithstanding the great care taken in sealing storage cases it is almost impossible to prevent some slight escape of volatiles, therefore a slight odor of ether in a magazine does not indicate deterioration. However, if the ether odor is persistently strong, it indicates a leaky storage case, which will be found by a process of elimination.

558. Testing sets are issued to each coast defense command for use in testing containers intended to be kept sealed air tight. When a leaky case

is found or the seal of a storage case of powder discovered to have been accidently broken, the container will be securely resealed without delay, unless the container is badly damaged, the powder believed to have been wet, or there are other unusual circumstances, in which case report will be made to the armament officer.

Inspection by the Ordnance Department

559. Samples of each lot of smokeless powder issued to the service are preserved in the laboratory of the Ordnance Department for chemical test. These retained samples are subjected regularly to technical inspection and test by that department to determine their condition as to stability. Should any lot show deterioration, the change is discovered by such inspection and the entire lot recalled from forts where it is stored.

Inspection of Forts

560. With each lot of powder supplied to a fort there is furnished a ground-glass-stoppered bottle containing a sample of the particular lot of powder. This bottle will be stored in the magazine with the corresponding lot of powder. The object of preserving this sample bottle in the magazine is to enable the responsible officer to keep his powder under regular observation.

561. A strip of dry tenth-normal methyl violet paper will be kept in each sample bottle at all times. The paper gradually loses its color in the presence of oxides of nitrogen as given off by decomposing smokeless powder. The time of test is the number of days required for the paper to lose all color and become entirely white.

562. A fresh strip of test paper will be inserted in the bottle every 30 days and will have entered on it in pencil the date when inserted. If desired, old strips may be left in the bottle for 30 extra days. All strips will be examined from time to time to detect change of color. The examination will be made without removing the stopper, except when the test paper is to be inserted or removed. The bottle will never be left open longer than is absolutely necessary, since the absorption of moisture and loss of volatiles due to exposure to the atmosphere affect the powder, while the escape of nitrous fumes that may have formed in the bottle delays the completion of the test. A perfectly stable powder will give a test of 60 days or more, but a test of 30 days indicates that the stability is reasonably satisfactory. If any sample causes the paper to turn completely white in 30 days or less, a report will be submitted by the coast defense commander, giving the data indicated on the blank form provided for that purpose.

563. Methyl violet paper is not affected by diffused light or ordinary handling, but will not be exposed to direct sunlight nor soiled by careless handling. Care will be taken not to handle the sample powder grains with moist fingers or to otherwise contaminate them.

* * * * * * * * *

PROJECTILES, FILLED AND FUSED

Storage and Care

569. These projectiles will be stored in the magazines provided for them, piled, and painted as required by existing orders.

570. They will be kept dry as possible and free from rust.

571. While premature explosions are not expected, projectiles filled and fused will be handled with great care.

Inspection

572. On account of the nature of the envelope, no inspection of the explosive is possible. The inspection of the projectiles will be limited to seeing that the requirements of "Storage and Care" are observed strictly.

PROJECTILES, FILLED BUT NOT FUSED

573. The fuse hole plugs should be set up fairly tight to exclude moisture. Fuse seats should not be formed unless it is actually intended to insert fuses. No danger from handling is to be expected, but care will be taken. The necessary fuses, base covers, etc., required to complete their preparation for service should be on hand at all times in boxes properly marked for identification.

Inspection

574. As prescribed for projectiles, filled and fused.

FIXED AMMUNITION

Storage and Care

575. Fixed ammunition for small arms or for cannon will preferably not be stored in the same magazine with other explosives. If the magazine is damp, the boxes will be piled on skids with strips between tiers and a space between boxes in a tier to permit the free circulation of air around the boxes.

Inspection

576. The inspection at forts will be limited to seeing that the requirements for its storage and care are observed strictly.

APPENDIX "J"

U. S. AUTOMATIC PISTOL, CALIBER .45

MODEL OF 1911

Q. Point out the following parts:

Receiver	Plug
Barrel	Extractor
Slide	Ejector
Slide stop	Firing pin
Rear sight	Hammer
Front sight	Disconnector
Link	Trigger
Link pin	Grip safety
Barrel bushing	Safety lock
Recoil spring	Magazine
Recoil spring guide	Magazine spring
	Magazine catch

Q. What is the kind and weight of the charge of powder for the pistol cartridge?

A. Smokeless powder. The weight varies slightly, but is about 5 grains.

Q. Describe the bullet for the pistol cartridge.

A. The body of the bullet is a cylinder. It has a core of lead and tin composition inclosed in a jacket of cupro-nickel. It weighs about 230 grains.

Q. What is the muzzle velocity of the pistol cartridge?

A. 802 feet per second.

Q. Why is this pistol called the automatic pistol?

A. Because, on being fired, the work of opening the breech, cocking the hammer, extracting and ejecting the empty shell, and forcing a new cartridge into the chamber, is done automatically by the force of recoil.

Q. How is this done?

A. The recoil forces the slide back; as it moves to the rear it compresses the recoil spring, opens the breech, extracts and ejects the empty shell, and cocks the hammer; the recoil spring then sends the slide forward, and in the forward movement it forces the new cartridge, which is pushed up from the magazine by the magazine spring, into the chamber ready for firing.

Q. How rapidly may the pistol be fired?

A. It has been fired twenty-one times in twelve seconds. Under ordinary conditions it may be fired as rapidly as the soldier is able to aim and pull the trigger.

Q. How is the pistol rifled?

A. It has six grooves, 0.1522 inches wide and 0.003 inches deep, and six lands 0.072 inches wide. The twist is to the left, one turn in 16 inches.

Q. What effect has this left-handed twist on the trajectory?

A. It causes the bullet to drive to the left.

Q. How is drift overcome?

A. It is more than overcome by the pull on the trigger when the pistol is fired from the right hand.

Q. For what use is the pistol intended?

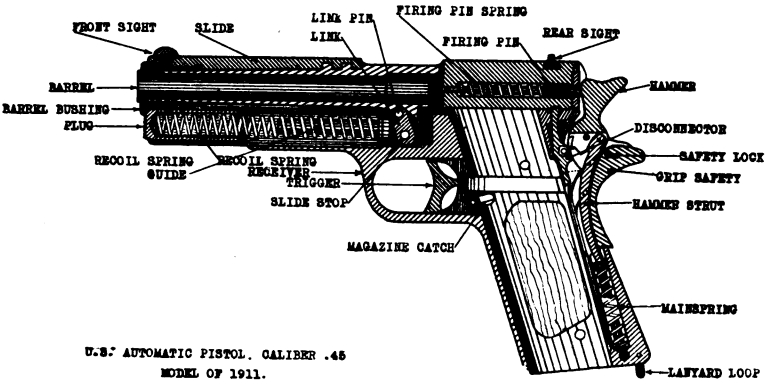
A. It is an emergency weapon for use at short ranges.

Q. For what ranges is the pistol accurate?

A. For ranges up to 75 yards.

Q. With what safety devices is the pistol provided?

A. It is impossible for the firing pin to touch the primer except on receiving the full blow of the hammer. The automatic disconnector prevents the release of the hammer unless the slide and barrel are in the firing position, and also prevents more than one shot from following each pull of the trigger. The automatic grip safety at all times locks the trigger unless the handle is firmly grasped as in firing, which pushes the grip safety in and releases the trigger.



U.S. AUTOMATIC PISTOL, CALIBER .45
MODEL OF 1911.

Q. What oil may be used on pistols?

A. For metallic surfaces, sperm oil, cosmic, or other oil furnished by the Ordnance Department. When pistols are stored cosmic is used. Raw linseed oil may be used on the wooden portions of the stock.

APPENDIX "K"

THE BATTERY COMMANDER'S TELESCOPE MODEL 1915

(SCISSORS TELESCOPE)

Q. What is the B. C. Telescope, Model of 1915?

A. It is a land observation instrument of the binocular type. It may be used with the telescope tubes in the erect position for periscopic vision, or in the horizontal position for stereoscopic vision.

Q. What is meant by periscopic vision?

A. When the telescope tubes are erect the instrument may be used to look over an obstruction while the observer remains concealed or protected.

Q. What is meant by stereoscopic vision?

A. When the tubes are in the horizontal position, the distance between the objective prisms is about 10 times as great as that between the eye pieces. This causes the objects viewed to be brought strongly into relief.

Q. How is the instrument graduated to read horizontal angles?

A. In mils, in a clock-wise direction.

Q. Where are these angles read?

A. The hundreds of mils are read on the azimuth scale which is graduated into 64 equal divisions, each representing 100 mils, and mils are read on the azimuth micrometer which is graduated into 100 equal divisions each representing one mil.

Q. Where are the angles of sight read?

A. On the angle of site scale which has graduations reading from 0 to 6, each division representing 100 mils and on the angle of site micrometer which is graduated into 100 equal divisions each representing one mil.

Q. How large an angle of site may be read?

A. The instrument has a movement of 300 mils in elevation and 300 mils in depression.

Q. What is the method of measuring angles of site?

A. The telescopes are focussed on the point in question and the horizontal line of the reticule brought on the point by means of the elevation knob. The angle of site level bubble is then brought to the center of the tube by turning the angle of site micrometer knob. The angle of site is then read from the scale and micrometer. Since 300 mils is the reading for zero angle of site, angles less than 300 mils will be angles of depression and angles greater than 300 mils will be angles of elevation.

Q. Explain how this instrument is set up?

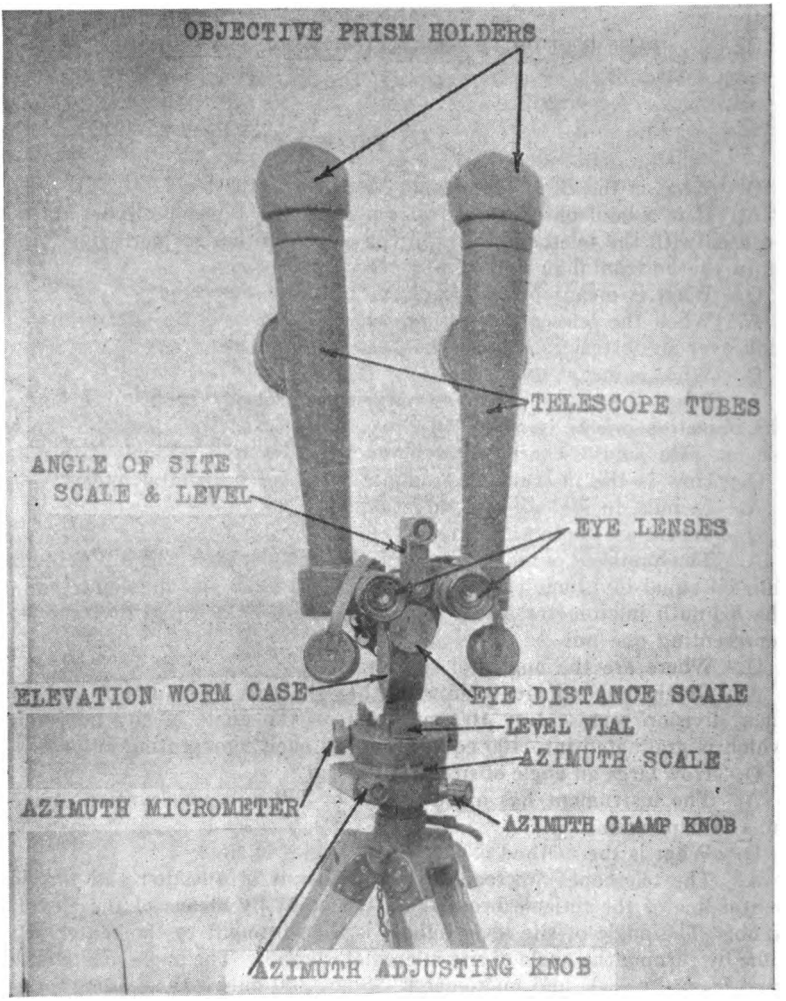
A. 1. Set up the tripod—see that the legs are evenly spaced, securely fixed in the ground and clamped.

2. Level the head by means of the vertical spindle ball and socket joint and the level bubble. Tighten the vertical spindle clamp.

3. Holding the locking plunger in the release position (pushed in) set

the telescope down upon the vertical spindle. When all the way down it will lock in position.

4. Focus the telescope. Each eye piece should be focussed separately on a far distant object until it appears as distinct as possible. The numbers



opposite the index on the diopter scales on each eye piece should then be memorized for future use.

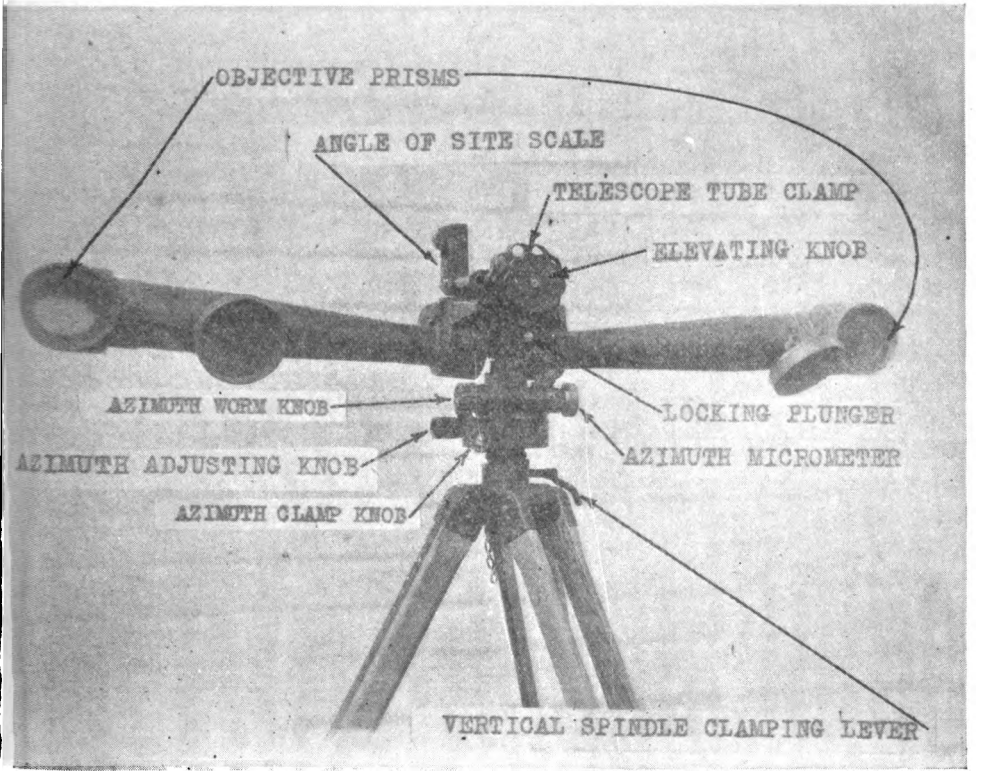
5. Move the telescope tubes (in either vertical or horizontal position) until both fields of view appear as one. The eye pieces are now the proper distance apart, and the resulting number opposite the index on the eye-distance scale should be memorized for future use.

Q. Explain how to orient the instrument.

A. 1. Having set up the instrument, set the azimuth scale and micrometer to the azimuth of the known datum point.

2. Loosen the azimuth clamp knob and turn the instrument so that it is approximately on the point. Tighten the azimuth clamp knob.

3. By turning the azimuth adjusting knob bring the vertical line of the



reticule in the right hand telescope exactly on the datum point. The instrument is now oriented and azimuths in mils may be read by turning the upper motion. It may be turned freely by using the azimuth worm lever which throws the azimuth worm out of mesh, or by means of the azimuth worm knob which is a slow motion screw.

CAUTION: When the instrument has been oriented, care must be taken not to touch the azimuth clamp knob or the azimuth adjusting screw knob.